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GENERAL

1035 Atomic energy and fire protection. Edward J. Kehoe. *Safety Engr. 98*, 20-1, 42-6 (1949) July.

The author discusses fire protection in Atomic Energy Commission plants and some of the hazards which would be encountered by fire department personnel. These are: radiation hazards, use of respiratory equipment in plants handling uranium or beryllium, keeping water run-off to a minimum, and the handling of pyrophoric materials and fires.

BIOLOGY AND MEDICINE

1036 Tabulation of available data relative to radiation biology. Andrew H. Dowdy. AECU-353, Feb. 1, 1949. 48p.

The report tabulates data on the following subjects for several species including humans, rats, mice, guinea pigs, dogs, fruit flies, and grasshoppers: histogenetic and genetic effect of radiations; effect of irradiation upon gonads; incidence of leukemia; hematological effects other than leukemia; acute total body irradiation of rats with 250-kvp hematological effects; embryological effects of irradiation; neutron-roentgen ratios; mortality table for x-radiation; mortality—chronic x-radiation from 3 r - 10 r/day; longevity table for x-and γ-radiation; effect of radiation—human cases; effect of total body irradiation—human cases; comparison of radiation effect by total dose, 26 cases; techniques employed for total irradiation; summary—polycythemic and leukemic patients living 1 year or more; chemical aspects of x-radiation. The data tabulated in the several tables listed above is summarized. The estimated results to humans exposed to filtered 200-1000 kvp x-rays are listed. The appendix includes discussions of the general background material concerning the effects of radiation on chromosomes, genetic changes in human sperm and eggs caused by single exposures of 300 r or less, and induced mutation rates.

1037 The response of the guinea pig to 200 r acute whole body x-irradiation. Thomas J. Haley and D. Harriette Harris. AECU-357, July 1, 1949. 10p.

It is concluded that the guinea pig responds similarly to other animals subjected to x-irradiation and that for many purposes is much more suitable for such studies than the mouse or rat. Extremely valid results may be obtained using the guinea pig because its size and general temperament are suitable for studies employing large numbers of animals. However, all hematological studies should be reported in both relative and abolute terms to avoid a misinterpretation of the results observed.

1038 The action of radiation on living cells (Editorial). *Radiology 52*, 428-30(1949) Mar.

The effects of various amounts of radiation on normal tissues and tumors through inhibition of mitosis and destruction of chromosomes are discussed and reviewed and pertinent literature is cited. It is noted that the permanent effects of radiation on the tumor cells consist of gene-mutations and structural changes in the chromosomes. The different sensitivity of the normal and tumor cells to radiations could be attributed to differences in their life cycles. It is stated that the tumor cells are affected in two different ways: indirectly by the radiation-induced changes in the normal cells and tissues surrounding the tumors (which seem to facilitate the tumor response), and by the direct methods mentioned above. In conclusion it is pointed out that the various forms of radiation response in tumors may represent the reactivity of several separate stages of tissues and cells; this would account for the complexity of the total response.

1039 Biological reactions caused by electric currents and by x-rays. J. Th. Van der Werff. Elsevier Publishing Company, Amsterdam and London. 1948. 203p.

The main thesis of this book, which concerns itself with the experimental data accumulated by both radiologists and physiologists, is that in all living organisms parts are continuously being destroyed and then regenerated. A beam of radiation is thought to change the dissimilation coefficient and thereby the assimilation process. This premise is the basis of mathematical derivations which correlate the data from the two sources. The derived curves often fit the actual observations.

1040 Effects of continuous radiation on chick embryos and developing chicks. I. Growth rate, gonads, and bone. II. Bone marrow, lymphoid tissue, and peripheral blood. Shields Warren and Frank J. Dixon. *Radiology 52*, 714-29; 869-80(1949) May and June.

This report is divided into two parts. Three sets of experiments were performed on chick embryos and young chicks utilizing P^{34} combined as KH_2PO_4 in order to study the effects of

BIOLOGY AND MEDICINE (continued)

radiation on these organisms. In the first group, White Leghorn embryos in the fourth to fourteenth day of incubation were given single injections, varying in amounts of P^{32} from 47.5 to 300μc. In the second group, chicks 1 to 37 days old were given single subcutaneous injections with isotonic solutions of P^{32}, in concentrations of 115-1,050μc. The third group consisted of chicks receiving multiple P^{32} injections, the total dosage being 180-3,696μc. Part one deals with the effect of radiation on the bones, growth and sex organs of the chicks and embryos. The results show that the P^{32} was mainly concentrated in the long bones of both the embryos and the chicks, and caused considerable overall growth retardation, resulting in small but well proportioned birds. Both the testes and the ovaries were found to be among the most radiosensitive of the organs and were the least able to recover from the injury caused by continuous radiations. The primitive sex cells in either gonad were the most sensitive element. The spermatogenic cells of the testes remained extremely radiosensitive throughout their development, while the ova became more radioresistant as they matured. The somatic cells of the gonads were much more radioresistant than the sex cells, but their rate of growth was inhibited following injury to the sex cells. In bone growth retardation, the cartilage cells of the epiphysis were much more radiosensitive than the osteoblasts and osteoclasts. After radiation ceased, the bones regained a normal histologic structure but remained dwarfed. Part two deals with the effects of radiation on the bone marrow, lymphoid tissue and the peripheral blood of the Leghorn chicks and embryos. The radiations had crucial effects on the blood-forming tissues, since the P was concentrated most heavily in the bone marrow; maturation of the hematopoietic cells was inhibited and mitotic activity was reduced. These changes were reversible and after the radiation had diminished, the bone marrow returned to normal. The larger doses of radiation, which eventually caused a fatal anemia, produced an immediate and virtually complete cessation of mitotic activity and maturation. In this group, after the radiation had decreased significantly, the few remaining hematipoietic and reticulo-endothelial cells began to show mitotic activity and maturation, but in an amount insufficient to prevent the development of an anemia which proved fatal several days later. The lymphoid tissue of the thymus was also very sensitive to radiation and showed an almost immediate marked reduction of mitotic activity, which lasted until most of the retained P^{32} had been concentrated in the bones. Recovery was rapid, and all but the most severe of these injuries to the lymphoid tissue were reversible. Peripheral blood counts followed a definite pattern during and following irradiation: the lymphocyte count fell first and recovered before the other cell types; the granulocyte count fell next most rapidly and recovered most slowly; the red cell count dropped most slowly and returned to normal midway between lymphocyte and granulocyte counts.

1041 Effect of diathermy (short wave and microwave) on bone growth in the albino rat. Charles S. Wise, Benjamin Castleman, and Arthur L. Watkins. *J. Bone and Joint Surg.* 31-A, 487-500 (1949) July.

Experiments testing the effects of short wave and microwave exposure on the bone growth of the knee joint region in 50 albino rats are described. Animals under intraperitoneal nembutal anesthesia were exposed to microwave radiations emitted from a microtherm; the source of the radiation was placed at different distances from the limb for the individual animals; the power output of the machine was also varied; the time was constant (ten minutes in each case), except for one animal which received radiation at low intensity for 40 minutes. Soft-tissue injury following large doses of shortwaves or microwaves showed a correlation to the applied voltage, but with sufficient variation to obviate accurate dosage calculations. Moderate soft-tissue damage was sometimes accompanied by bone injury (shortening of the bone, deformity, and partial or complete epiphyseal destruction; extensive bone absorption and a resulting flail extremity was present following microwave injury of the soft-tissue. In two clinical cases discussed, extensive bone disturbances followed diathermy treatment in children, which may contra-indicate this type of therapy.

1042 Effect of radiation on hemopoiesis. Is there indirect effect? J. S. Lawrence, W. N. Valentine, and A. H. Dowdy. *Blood* 3, 593-611(1948).

A similar article by the authors was published in *Radiology* 51, 400-13(1948) Sept. It was listed in Nuclear Science Abstracts as Abstract 1-1241.

BIOLOGY AND MEDICINE (continued)

1043 The lethal dose of total-body x-ray irradiation in swine. John L. Tullis, Carl F. Tessmer, Eugene P. Cronkite, and F. W. Chambers, Jr. *Radiology 52*, 396-400(1949) Mar. (See also Nuclear Science Abstract 2-36 and 2-1656).

Adult, healthy, hybrid swine were exposed in groups of eight (four males and four females) to predetermined amounts of total-body radiation delivered in succession to each lateral aspect of the body one meter from a 1,000 kv, 3-ma, x-ray source. Within a 30-day period following exposure, animals died from the effects of irradiation in the proportions of 1 of 8 (12.5%) that received 200 r, 5 of 8 (62.5%) that received 300 r, 7 of 8 (87.5%) that received 400 r, and 8 of 8 (100%) that received 600 r. The 30-day per cent mortality plotted as a function of the bilaterally administered dose gave an "S"-shaped curve, the LD 50/30 of which was taken by interpolation to be 275 r.

1044 Measurement of ionizing radiations in vivo. Benedict Cassen and Lawrence Curtis. *Science 110*, 94-5(1949) July 22.

A method for measuring the intensity of the ionizing radiations received in vivo during roentgen or other irradiation is presented and the apparatus is described in detail. The transmitting mechanism from the source being ionized in vivo to the photomultiplier used for the actual qualitative measurements consists of an internally polished No. 15 hypodermic needle, the tip of which nearest the emission source is plugged with a small piece of lucite containing a few crystals of zinc sulfide adhering to the exterior surface; this surface is partially extruded from the needle into the point of contact and the radiations are then transmitted and measured. An amplifier is connected into the system when α-particle scintillations are to be observed. Further work is in progress to improve the described technique and to investigate the possibilities of measuring the local concentration of β-activity of radioisotopes in vivo.

1045 Relationships between chemical and biological effects of ionizing radiations. Raymond E. Zirkle. *Radiology 52*, 846-55(1949) June.

A discussion is presented of the nature of the connecting events occurring in the "latent period" which intervenes between the energy absorption in ionizing radiation conditions and the biological effects produced by these radiations. The author assumes that the formation of new combinations which produce the biological effects is brought about by chemical reactions. Two phases of the chemical reactions are discussed, the nature of chemical reactions and the manner in which they lead to the biological effect. Early relevant reactions may occur in the cell medium, and later ones at the cell surface or within the cell itself, due to the absorption of some chemical product. The possibility of the ionization of water by the radiations and the production of changes of many products in this medium in vivo are discussed. Three steps are proposed to study relevance of chemical reactions: a specific radio-chemical reaction must be suspected of relevance to a given biological effect; second, if the reaction is only known to occur in vitro it must be proved to occur in the intact and irradiated cell; third, if the reaction passes the foregoing preliminary tests, it must be connected to the biological effect by a definite procedure. An indirect method of substantiating the third step by correlation of the variations in biological effects with variations in the radiations is outlined. The author concludes by stressing the importance of chemists in the radio-biological field and the need for further knowledge of the mechanisms of radio-biological reactions. 25 references.

1046 Tumorous growths in the pituitary and trachea following radiotoxic dosages of I^{131}. Aubrey Gorbman. *Proc. Soc. Exptl. Biol. Med. 71*, 237-40(1949) June.

Investigations concerned with the possible occurrence of thyroidal tumors after partial β-ray destruction of the thyroid gland through the use of I^{131} are presented. One hundred and fifty-eight mice were given doses of 10, 50, 80, 100, 160, 200, 300, 400, 500, or 1,000 mc, were sacrificed up to 400 days after injection, and were examined for changes in their pituitary glands and tracheas. Tumorous enlargements were found in the pituitary sections; growths as large as 240 mg were present, and less than 10% of the animals sacrificed more than 250 days after the I^{131} injections had glands smaller than 10 mg in weight. Tracheal tumors of the fibrous tunica propria, obstructing the tracheal lumen were of lower incidence (4%) but appeared earlier. Fibrous thickenings of the tunica propria, and metaplastic regeneration of tracheal epithelium were more common.

BIOLOGY AND MEDICINE (continued)

1047 Plutonium and yttrium content of the blood, liver, and skeleton of the rat at different times after intravenous administration. Jack Schubert, Marium P. Finkel, Marcia R. White, and Gertrude M. Hersch. AECD-2651, May 19, 1949. Decl. July 19, 1949. 16p. Proposed for publication in *Science*.

Sprague-Dawley female rats, weighing between 236 and 254 g were injected intravenously via the tail vein with a 1% sodium citrate solution containing 24.3 μg of tetravalent Pu^{239} and 0.3 μg of trivalent Y^{91}. The animals were sacrificed in pairs at time intervals ranging from 5 min to 48 hr after injection, and the Pu and Y content of the blood, bone, and liver determined radiometrically. The changes in the Pu and Y levels in the blood, skeleton, and liver with time are shown graphically. Five min after intravenous injection about 50% of the Pu and about 80% of the Y had disappeared from the blood, and an appreciable fraction was already deposited in the liver and skeleton. After this intial sharp drop Pu disappeared more slowly from the blood; 12 hr after administration about 20% of the injected dose was still in circulation, while the Y level had fallen to 0.7%. The Pu content of the skeleton increased regularly until a maximum value of about 45% of the injected dose was reached at 24 hr; while in 6 hr the Y concentration was near its peak at 45%. Only 2 hr is required for the level of intravenously-injected alkaline earths (Ca, Sr, Ra) in bone to reach a maximum. After the initial rapid increase of the Pu and Y levels in the liver the level of Pu continued to rise at a diminished rate until it reached 24% of the injected dose at 48 hr. However, the Y level decreased very slowly after the second hr when the maximum level of close to 10% was attained. The results obtained are interpreted by consideration of the solution chemistry of radioelements.

1048 An ink writer for recording blood pressure, respiration, and other responses in small animals. Thomas J. Haley. AECU-267, June 23, 1949. 7p.

An ink writer has been devised from readily available materials. This instrument is reported as being useful in recording blood pressure, respiration, and other responses in small animals.

1049 The effect of added carrier on the distribution and excretion of soluble Be^7. R. R. Allen, G. Bonner, G. E. Kosel, W. F. Neuman, J. K. Scott, and A. F. Sparks. AECU-294, May 11, 1949. 22p.

A soluble compound of Be^7 only and one to which $BeSO_4$ was added as carrier were administered intravenously to rabbits and rats. The distribution and excretion of the Be^7 was determined by tracer techniques. It was found that when the isotope only was given that the Be^7 was deposited in bone and excreted in the urine. When $BeSO_4$ was injected simultaneously with the isotope appreciable amounts of the Be^7 were found in the liver, spleen and bone marrow in addition to that deposited in the skeleton and excreted in the urine. The rate of clearance of Be^7 from the circulating blood was much more rapid when isotope only was given than when carrier was added to the isotope. The urinary excretion of Be^7 was more rapid when isotope only was injected than when carrier was added. Significant amounts of Be^7 were excreted in the feces when isotope plus carrier was administered.

1050 A study of the air blast method for the evaluation of the effectiveness of flavanoid compounds on capillary fragility. Thomas J. Haley, Bonnie M. Rhodes, Benedict Cassen, Lawrence Curtis, and Katherine Kistler. AECU-361, June 21, 1949. 16p. Proposed for publication in *J. Pharmacol. Exptl. Therap.*

A study has been made of an air blast method for the evaluation of the potency of flavanoid compounds. The method, while it seemed to show that these drugs protected the lungs of mice from extensive capillary rupture, was of little value because the results obtained were in most cases not statistically significant. The use of sodium hydroxide as a solubilizing agent was found to be detrimental because that chemical exerted some slight protectant action itself.

1051 The use of x-rays to determine the mitotic and intermitotic time of various mouse tissues. Norman P. Knowlton, Jr., and William R. Widner. AECU-366, nd. 22p. Proposed for publication in *Cancer Research*.

A method of determining the mitotic time of various tissues of the mouse by means of the effect of x-rays on mitosis is presented. The mitotic time was found to vary from about 20 to 36 min in the seven tissues studied. The normal mitotic index of these tissues and the mitotic time were used to calculate the intermitotic time from the formula, Intermitotic Time = $\frac{\text{Mitotic Time}}{\text{Mitotic Index}}$. It is concluded that since the mitotic times were relatively constant as

BIOLOGY AND MEDICINE (continued)

contrasted to the intermitotic times, the differences in the mitotic indexes of the various tissues were due primarily to the variations in the intermitotic times. Thus, the mitotic index varies in inverse proportion to the intermitotic time and, in general, tissue sensitivity to x-rays increases the shorter the intermitotic time.

1052 The inhibition of malic acid oxidation in rat liver homogenates by octin-5-oic acid. James F. Mead. AECU-367, July 1, 1949. 8p. Proposed for publication in J. Biol. Chem. (Addendum to AECU-248).

Further experiments have been performed since the inssuance of AECU-248 which lead to the elucidation of the inhibition effects discussed in this report (See NSA 3-211). It was found that glutamic acid apparently reverses the octinoic acid inhibition. A possible explanation of the inhibition based on this reversal is given.

1053 Structural differences in bone matrix associated with metabolized radium. Frank E. Hoecker and Paul G. Roofe. *Radiology 52*, 856-65(1949) June.

The preliminary results of studies involving the distribution of metabolically deposited radium in rat bones are presented. Radium chloride was injected intraperitoneally in physiological saline solution into 12-week-old Wistar rats and the distribution of the radium in the tibias and and femurs was studied radioautographically through α-particle tracks in nuclear track plates. The studies demonstrated the existence of microscopic localizations of radium deposited metabolically in the rat bones; these localizations are described in detail. It is concluded that a consideration of the tissue dose due to an α-particle bombardment and the resultant tissue reaction in the sublethal dose region may offer a basis for a theory of the production of bone sarcomas in chronic radium poisoning. Further studies along this line are being pursued.

1054 The effect of several antihistaminic drugs on mortality due to x-irradiation. Thomas J. Haley and D. Harriette Harris. AECU-362, July 8, 1949. 23p. Proposed for publication in *J. Pharmacol. Exptl. Therap.*

A study has been made of the effect of several antihistaminic drugs on mortality due to x-irradiation in guinea pigs. The drugs investigated were synergistic with the radiation and increased its lethality. A significant decrease in the coagulation time was observed after antihistaminic therapy in both the medicated and the medicated irradiated groups. The antihistaminic drugs caused a pronounced leukocytosis in normal guinea pigs that received the drugs daily for periods of 14 to 23 days. Gall bladder rupture and enlargement of the common bile duct and gall bladder was observed in guinea pigs chronically medicated with antihistaminic agents. Pyranisamine was the only drug investigated which caused ulceration and perforation of the stomach. The leukocyte count in x-irradiated, medicated or non-medicated, guinea pigs follows the pattern seen in other species after irradiation.

1055 Atomic radiation effects: The release and neutralization of humoral toxic agents. R. deRohan Barondes and David I. Levine. *Military Surgeon 105*, 153-60(1949) Aug.

Some of the methods and measures that could be instituted to combat the toxic agents released in the human body during the course of radiation exposure are discussed and described. The immediate effects of strong irradiation, such as that delivered by an atomic bomb, consist of severe flash burns, incipent harm to the hematopoietic organs, shock, and disturbances of the electrolyte, osmotic and acid-base relationships. Low but prolonged exposure produces leukemia conditions, while more extensive irradiation has a destructive effect on the vital enzyme systems, both by a release of numerous toxic metabolites and protein degradation products and by a direct destructive effect; hepatic damage, pancytopenia, hypotension, toxemia, anoxemia, and adrenal failure may result. The role of carcinogens is discussed and the results of inhibition of cholinesterase are described. The polymerization and oxidation reactions stimulated by nuclear radiation are outlined; the roles of heparin and the adrenal cortical hormones and extracts are described. It is noted that the effects of the radiations and the degree of radiation resistance depend to some extent on the condition of the body at the time of exposure; senescence, organic disease, and other weakening conditions would decrease radiation resistance. The shock-reducing properties of ethanol and liver extracts are explained, and the importance of blood transfusion is mentioned. Adequate medical preparation is considered necessary to prevent large scale loss of life.

BIOLOGY AND MEDICINE (continued)

1056 Advances in internal medicine. Vol. 3. William Dock and I. Snapper. Interscience Publishers, Inc., New York, Interscience Publishers, Ltd., London, 1949. 478p.

This book is composed of ten sections, the first discussing the use of British-antilewesite (BAL) in the treatment of poisoning by arsenic, mercury, lead, gold, cadmium, and antimony, as well as several metal compounds. Protective dosage levels in man and experimental animals are outlined and the various preparations of BAL available are described. Another section deals with the treatment of hyperthyroidism by means of anti-thyroid compounds, and radioactive iodine is mentioned in connection with both the diagnosis and the therapy of this disease.

1057 Arthritis and related conditions. Edited by Theordore Franklin Bach. F. A. Davis and Co., Philadelphia, 1948. 452p.

Two chapters of this 28 chapter book are principally devoted to a discussion and description of the principles and methods of x-radiation therapy in arthritis cases. Indications of the variations in technique which are necessary to adapt the therapy to the individual case are brought out. The amount of knowledge of the conditions of the joints to be treated and the skill of the radiation operator are considered to be prime factors in the successful treatment of these cases.

1058 Blood groups and effects of roentgen irradiation in retrolental fibroplasia. Thomas O. Paul. *Arch. Ophthalmol. 41*, 659-66(1949) June.

Nine cases of retrolental fibroplasia which were treated with roentgen radiations are discussed. The radiation doses consisted of 100-200 r given at monthly intervals or at longer periods of time; the total dosages were 300-1,400 r. The conditions for the differential diagnosis of this congenital malformation are presented; a study of the possibility that a blood factor is a cause of prematurity led to no definite conclusion. The treatment by roentgen radiation produced little change in the condition of the patients.

1059 Carcinoma of the cervical stump. William E. Cbstolow. *Radiology 52*, 41-5(1949) Jan.

A series of 165 cases of carcinoma of the cervical stump is discussed and the methods of treatment are outlined. Radium and x-rays were used in combination in almost all of the cases. A total dose of 4,00-5,000 mg-hr was usually given by means of a flat vaginal radium applicator; in addition, roentgen therapy, consisting of a total tissue dose of 3,000-5,000 r, was delivered to the mid-pelvic region over a period of five to six weeks. A 5-year survival rate, without disease, of 30.7% was obtained in these cases.

1060 Carcinoma of the nasopharynx. C. Calvin Fox. *Arch. Otolaryngol. 48*, 390-401 (1948) Oct.

Twelve cases of transitional, squamous or anaplastic carcinoma of the nasopharynx are discussed. Since nasopharyngeal carcinomas are highly sensitive to roentgen rays, this therapy is generally used; an initial maximum dose is usually given unless excessive mucous secretion or drying occurs. Larger fields are treated with up to 250 r/day for a total of 2,500-3,000 r (in air), and if two smaller fields are used instead, the daily dose is 125-150 r for each field. In addition to the radiation described for the frontal area, each antral area is irradiated with a total of 2,000-2,500 r through daily doses of 225-250 r. Radiations above the brow and down through the petrosa are then given at the same dose levels, and a final set of radiations is administered through the orbit. The survival period shows wide variation; six patients are living and six are dead, the interval from the primary symptoms and death varying from 6 to more than 27 months. The 5-year survival rates are incomplete at this time.

1061 Concerning the treatment of cutaneous epithelioma. Jose Fernandez Colmeiro. *Anales Facultad Med. 33*, 1208-17(1948) Nos. 11 and 12 (in Spanish).

A description is given of the types of epithelioma of the skin and their diagnostic and clinical manifestations. Basal cell epitheliomas, epidermoidal epitheliomas, melanocarcinomas, and adenocarcinomas are discussed. The types of roentgen therapy used in the treatment of these epitheliomas are the method of Chaoul, 100 kv therapy, and 150-180 kv therapy. Doses of 2800 r given in 10-15 days cause the diminution of most of the epitheliomas while doses of 3200-3500 r cause the sterilization of some of the epitheliomas. Baso-epitheliomas and epidermoidal epitheliomas are successfully treated with 4500-5000 r over a period of a month.

BIOLOGY AND MEDICINE (continued)

1062 Contributions for the therapy of carcinoma of the vulva. A. Kotek. *Krebsarzt 4*, 90-4(1949) Mar. (in German).

Four methods of treatment of carcinoma of the vulva are described which were used in the treatment of 70 cases. These four methods are: the radical operation method with prophylactic post-operative roentgen radiation; radium and roentgen radiations; contact radiations with the Schaefer-Witte method; and, electro-coagulation. The prophylactic roentgen technique in all cases so treated consisted of a total dose of 2,000 r given in ten sittings. Contact irradiation of the vulva by the Schaefer-Witte method was used in only five cases, since the long administration time (30 stages) for this method made it generally undesirable; a total of 2,000 r was delivered to the tumor in each case. The radium-roentgen method administered in 35 cases yielded a healing rate of 11.4%; the radical operation method was next most frequently used and produced a cure rate of 69.2%, but was limited in some cases by the age of the patients. It is concluded from the high electro-coagulation cure rate (75%) for four cases, that this method may be the treatment of choice for aged patients and that the radical operation method should be reserved for the younger patients.

1063 The diagnosis and treatment of primary ovarian carcinoma with special reference to radiation therapy. John H. Freed and Eugene P. Pendergrass. *Cancer Research 8*, 361-70(1949) Aug.

The records of 87 patients with a histological diagnosis of carcinoma of the ovary who received radiation therapy are reviewed with particular reference to the value of the therapy. Of these patients, 72% were from 40 to 69 years old. The radiation treatments usually consisted of a total of 1,500-3,000 r delivered at each series of treatments with individual doses of 200 r to each of two pelvic portals daily or on alternate days. Several series were usually given with rest intervals of one to four months between. Fifty-five patients received abdominal radiations as well, consisting of a total of 200-2,500 r delivered in smaller doses. The total five year survival rate for this series was 39.2%. It is concluded that post-operative irradiation is of definite value in cases of extension or metastasis at operation both in the relief of symptoms and the prolongation of life. It is also concluded that the maximum tumor dose should be given whenever possible. 27 references.

1064 Dysgerminoma--case with pulmonary metastases; result of treatment with irradiation and male sex hormone. P. E. Russo and J. W. Kelso. *Radiology 52*, 367-70(1949) Mar.

An unusual case of pulmonary metastases from dysgerminoma is presented in which x-ray therapy and male hormone administration were used for treatment after an operation. The post-operative irradiation consisted of a total dose of 900 r in air delivered to each of eight fields, four abdominal and four dorsal, by a 200-kv machine through a Thoraeus filter at 50 cm target distance; the daily dose was 300 r to one field. On readmission 3½ years later for axillary and thigh metastases, the axillary site was irradiated with a total dose of 2,400 r in air, with a consequent 50% regression. Stationary conditions were maintained for 5 months; then, as a result of hematuria and pains, administration of testosterone and, later, a final course of irradiation was instituted. Death occurred 7½ years after the onset of the symptoms. Pulmonary metastases were first observed about 3 years after the operation for the primary tumor, and were treated with deep x-rays which caused less than 50% regression. Gradual involvment of both lungs, superficial and deep lymph chains, subcutaneous tissues, liver, and both kidneys occurred. The authors note that the radiosensitivity of dysgerminoma is not extremely large.

1065 Election of the treatment in epithelioma of the larynx. José Fernandez Colmeiro. *Anales Facultad Med. 33*, 1218-23(1948) Nos. 11 and 12 (in Spanish).

A general discussion is presented in which the literature is reviewed and the epitheliomas of the larynx are divided according to their anatomical locations; the cure rates are given for each of the three major locations and according to the therapy used. The epitheliomas were treated by radiotherapy, surgery, or a combination of these two methods. Cure rates of 19.3 and 17% are quoted from previous workers using radiation therapy alone. Changes in the therapeutic technique produced cure rates of 14.4-100% for the different types. In a series of cases described, the cure rate for the combination surgery-radiation technique is 58%, or 17% better than the results of laryngectomy alone.

BIOLOGY AND MEDICINE (continued)

1066 Endocrine factors in hypertension; treatment by roentgen irradiation of the pituitary and adrenal regions. James H. Hutton, James T. Case, Ernest C. Olson, Warren W. Furey, Stanley Fahlstrom, William L. Culpepper, and Earl E. Madden. *Radiology 52*, 819-28(1949) June.

X-ray therapy is discussed in connection with the treatment of hypertension and the technique and results are described. A 120-kv machine with a 3-mm Al filter at a target distance of 50 cm was used to deliver an average dose of 50 r to each area treated. Doses were continued up to a maximum of 300 r if no relief from the hypertension was noted. Careful checking of the blood pressure was performed after each treatment, and if the pressure dropped sufficiently, no further treatments were given until the pressure rose again. A total of 70.4% of the 85 cases under consideration showed improvement after three or more treatments and no evidence of x-ray damage was noted; in two cases postmortem studies indicated no injury to the pituitary, adrenals, or other tissues which were irradiated. 20 references.

1067 Eosinophilic granuloma of the bone. B. Walthard and A. Zuppinger. *Schweiz. Med. Wochschr. 79*, 618-23(1949) July 9 (in German).

Eight cases are presented and described in which the therapy is either surgical or radiological. The roentgen therapy used was the fractionated method, with a total dose of 1,500-2,000 r delivered over a period of time through doses of 150-200 r. Previous investigators report the absence of rapid bone regeneration after radiation therapy of the tumorous regions, but indicate that the roentgen therapy may be of some use in the temporary relief of pain. The authors indicate that their cases reported here show that regeneration may occur for as long as 6½ years after intense roentgen radiation. Therefore, the radiation therapy seems to be of some definite use in these cases.

1068 Evaluation of the effects of radiation on non-malignant lesions of the nasopharynx. M. H. Cutler, Richard E. Marcus, and Francis L. Lederer. *Radiology 52*, 816-8(1949) June.

A series of 50 patients is presented in which the effects of radiation therapy of non-malignant lesions of the nasopharynx are discussed. The cases are divided into four groups according to the symptoms. The radiation dosages are not given. The results indicate that this type of therapy, when combined with other forms, is useful in the treatment of a syndrome comprising impaired hearing of transitory nature and allergic symptoms in the child. Radiations may also be of value in cases of mild disturbances of eustachian tube function. 12 references.

1069 Five-year end-results of irradiation therapy of cancer of the cervix uteri at the Memorial Hospital. Equinn W. Munnell and Alexander Brunschwig. *Surg. Gynecol. Obstet. 87*, 343-8(1948) Sept.

This report covers the five-year results in 1,072 patients with cancer of the cervix uteri. Two types of roentgen therapy were used; these were the massive dose technique and the divided dose technique. The first consisted of a single treatment of 750 r to each of four pelvic portals, and the second consisted of a series of 12 treatments of 200 r each to each of six fields, delivered at 70 cm target distance at 200 kv through a 0.5 mm Cu filter. The external roentgen therapy was a supplement to the application of radium in the form of a cervix tandem to the uterus; this method delivered 3,000 mg-hr of radium within the cervix, and a similar vaginal applicator was used to deliver a dose of 1,500 mg-hr against the cervix. Tables of the patients examined, the patients radiologically treated, the results of the treatments, and the evaluation of the results are included. The data show that the five-year overall cure rate for the 1,037 patients treated by irradiation was 28.6%. The results suggest some form of change in the treatment of these cases, and the authors raise the question of a combination of irradiation and surgical treatment.

1070 One hundred and seventeenth annual meeting of the British Medical Association. *Brit. Med. J.* No. 4618 70-93(1949) July 9.

Among the topics discussed at the one hundred and seventeenth annual meeting of the British Medical Association held at Harrogate, England, in June, 1949, were the following: (Section of Radiology, Tuesday, June 28, 1949) Scope and limitations of radiotherapy; and, (Section of Radiology, Wednesday, June 29, 1949) Radiotherapy in Sponylitis Ankylopoietica and Osteoarthritis.

BIOLOGY AND MEDICINE (continued)

1071 On the tendency of Ewing's sarcoma to heal spontaneously, and on the alterations due to irradiation. Lars Unander-Scharin. *Acta Orthopaed. Scand. 18*, No. 4, 436-476(1949).

A pathological study was made of 33 cases of Ewing's sarcoma, 17 of which received irradiation, and a comparison was drawn between the irradiated cases and the non-irradiated cases. The radiation doses administered were 100-400 r for the individual treatments with total dosages of approximately 1,600-7,000 r. The doses were given as the primary course or as post-operative treatment, and as such were delivered to medial, lateral, posterior, or frontal fields and combinations of these fields. The changes of cytolysis and fibrosis, which were observed in the cases that were irradiated, were also observed to a lesser extent in the untreated cases. This is interpreted as a tendency for spontaneous healing in cases of Ewing's sarcoma. The presence of small and large groups of viable tumor cells after irradiation is thought to suggest that irradiation should always be combined with radical surgery in the treatment of this disease. The presence of coarse cells within the tumor indicates resistence to the effects of irradiations, partially due to the fibrous content of the tumor and to some changes in the internal constitution of the tumor cells. 45 references.

1072 Problem cases of toxic diffuse goiter treated with radioactive iodine. Myron Prinzmetal, Clarence M. Agress, H. C. Bergman, and Benjamin Simkin. *J. Am. Med. Assoc. 140*, 1082-89(1949) July 30.

Radioactive iodine was used in 18 problem cases of severe toxic diffuse goiter (Graves disease) and was administered in total doses of 1.5-14.5 mc. There were five classifications of complications: three cases of congestive heart failure; three cases of extreme emotional instability or psychosis; three cases of extreme toxicity; eight cases of recurrence after previous thyroidectomy; and one case of thyroid malignancy. Of the 18 patients, 16 were brought to a euthyroid state; one died of unknown cause several months after a complete remission; one patient still had mild toxic symptoms after the therapy; and one patient was a therapeutic failure.

1073 Quality, intensity, and field distribution of radiation emitted from a new type of low voltage roentgen therapy tube. Henry M. Lewis and Arthur Mutscheller. *J. Investigative Dermatol. 12*, 325-30(1949) June.

The physical characteristics of a new type of superficial roentgen therapy tube are described. It is noted that the preferred measurement of radiation quality today is the half-value thickness layer of Al, which indicates the hardness or the incident beam and affords a method of measuring the extent of skin penetration. Field distribution and its measurement is discussed and described. The therapy tube is considered to be ideal for operations in the grenz ray range and is purported to be of sturdy construction. It is concluded that some effort should be made to manufacture tubes which provide for a uniform intensity of field radiation, which is very important therapeutically.

1074 The radiation treatment of larynx and pharynx tumors. A. Zuppinger. *Strahlentherapie 78*, No. 4, 481-500(1949) (in German).

A radiation method for the treatment of laryngeal and pharyngeal tumors is presented. The technique consists of delivering the radiations through a 1.7 mm Cu filter twice daily; doses of 200-250 r are given at an intesity of 10-20 r/min at a focal distance of 50-60 cm, and each field is irradiated only once daily. The total dose varies greatly, depending on the individual reactions and the presence of metastases. If the tumor does not disappear within the course of radiations for 4-5 weeks, radiations are continued until it is not possible to irradiate further. During and after the therapy, carcinomas and sarcomas developing as a result of the radiations were never observed; strong radiation reactions were observed when the radiation doses were increased toward the end of the therapy courses. It was noted that the round-cell sarcomas were the most sensitive to the radiations, and were about twice as sensitive as the highly sensitive lymphosarcomas. Other observations are described. It is concluded that the intra-laryngeal irradiation with tumors of the inner portion of the larynx is of only limited application; the method of fractionation and the technique used are of importance in the successful treatment of these cases. 20 references.

BIOLOGY AND MEDICINE (continued)

1075 Review of ten years experience with transvaginal roentgen therapy. Ralph M. Caulk. *Radiology 52*, 26-33(1949) Jan.

The methods of administering radiation therapy and the results of treatment of 262 unselected cases of carcinoma of the cervix are presented. Six methods were used: transvaginal therapy only, consisting of daily doses of 800 r, for a total dose of 5,000-8,000 r; external roentgen therapy supplemented by transvaginal therapy; external roentgen therapy supplemented by transvaginal roentgen therapy plus intrauterine and intracervical radium therapy; external roentgen therapy supplemented by transvaginal therapy, plus radium applied locally to the cervix; transvaginal therapy plus intracavitary radium; and, transvaginal therapy plus local radium. The survival rate is listed according to the method administered and the transvaginal therapy technique is described in detail. The absolute 5-year to 10-year survival rate was 35% for all of the methods used. Possibilities for increasing the desirable results in cases of carcinoma of the cervix are suggested.

1076 Roentgen therapy of subdeltoid bursitis; review of 235 cases. W. W. Lattomus and L. M. Hunter. *Delaware State Med. J.* 21, 115-7(1949) July.

A review of 235 cases of subdeltoid bursitis treated with roentgen therapy is presented. Two techniques of treatment were used, low voltage and deep roentgen radiations. The low voltage treatment consisted of a total dosage of 400 r in air given in daily doses of 100 r, 150 r, and 150 r. A 120-kv machine was used and the radiations were delivered through an equivalent of 4 mm Al at 30 cm target skin distance. The deep therapy consisted of a total dosage of 600 r in air, 200 r being given on alternate days for three doses at 200 kv through 0.5 mm Cu and 0.5 mm Al at 50 cm target distance covering a circular area of 12 cm in diameter. A total of 183 patients were treated in the 400 r group, 45 of which were classified as acute. The results show that 90.9% of the acute cases were cured or improved, 82% of the subacute cases and 55.8% of the chronic were also improved. Of 52 patients treated by the 600 r method, 100% of the acute cases were cured, 60% of the subacute cases and 47.4% of the chronic cases experienced improvement or complete relief. The best results were obtained with the acute cases of bursitis, either first attacks or acute exacerbation of the chronic condition. The results indicate both methods are equally effective in the treatment of these cases.

1077 Sarcoma of the uterus--a report of nine cases. Stanley B. Reich. *Am. J. Roentgenol. Radium Therapy 61*, 830-8(1949) June.

The incidence, pathology, diagnosis, and treatment of sarcoma of the uterus are described and nine cases are presented. Roentgen therapy was administered post-operatively in three cases and consisted of: in the first case, a 100% erythema dose to four pelvic portals; in the second case, 750 r (measured in air) over two anterior pelvic fields and 600 r over two posterior fields; and in the third case, 1,500 r to each of two anterior pelvic portals, 1,800 r to each of two posterior pelvic fields, and 1,350 r to each of two lateral pelvic fields. Six inoperable cases were treated with palliation therapy of about 2,000-4,000 r to a total of two to six pelvic fields and three of these cases enjoyed a comfortable, prolonged life. It is concluded from the much extended life of the operable cases and from the results of the inoperable cases that roentgen therapy of the high voltage type use here, 200 kv is an excellent method of treatment. 16 references.

1078 The therapy of carcinoma of the uterine neck with special emphasis on radium administration. Karl Weghaupt. *Krebsarzt 4*, 19-30(1949) Jan. (in German).

Of 161 cases of carcinoma of the neck of the uterus, 69 were operated on by the radical method and given post-operative combined radium and roentgen therapy. The remaining cases were treated therapeutically by radiations alone. In the radium-roentgen dose method, radium was given in vaginal applicators for a total dosage of 7,200 mg-hr over a considerable period of time; the roentgen radiations were begun 4 weeks after the close of the radium treatments and consisted of a total of 1,600 r delivered by the deep dose method. The combined surgical and post-operative radiation therapy method yielded a cure rate of about 58%, while the irradiation therapy method alone had a cure rate of about 36.6%. It is concluded that an accurate pre- and post-operative technique is essential for the operable cases of carcinoma of the uterine neck.

BIOLOGY AND MEDICINE (continued)

1079 Thimble chamber calibration on soft roentgen rays. F. H. Day. *Am. J. Roentgenol. Radium Therapy 61*, 543-9(1949) Apr.

This article was published in the *J. Research Natl. Bur. Standards 41*, 295-300 (1948) Oct. It was listed in *Nuclear Science Abstracts* as Abstract 2-225.

1080 The path of carbon in photosynthesis. V. Paper chromatography and radioautography of the products. A. A. Benson, J. A. Bassham, M. Calvin, T. C. Goodale, V. A. Haas, and W. Stepka. AECU-356, June 13, 1949. 32p.

Paper chromatography has been employed to separate the radioactive products formed during photosynthesis in $C^{14}O_2$. The method has been used for the separation and identification of carboxylic acids and phosphate esters. The first observed product of carbon dioxide assimilation during photosynthesis has been isolated and shown to be phosphoglyceric acid.

1081 Concentration-time course in the plasma of man of radiomercury introduced as a mercurial diuretic. S. A. Threefoot, C. T. Ray, G. E. Burch, J. A. Cronvich, J. P. Milnor, W. Overman, and W. Gordon. *J. Clin. Invest. 28*, 661-70(1949) July.

Fifteen patients were studied through the use of mercurydrin labelled with radiomercury in order to determine the concentration-time course of mercury intravenously injected into the circulating plasma. The mercurial diuretic was injected over a period of 20 seconds in each case, and blood samples were withdrawn at intervals beginning with the injection; regression curves were then plotted. An analysis of these curves demonstrates that there are at least three major exponential rates responsible for the decline in concentration of mercury in the plasma. The first rate is dependent upon mechanical mixing; the second is possibly due to relatively rapid absorptive, chemical, and diffusion phenomena with migration into dynamic and more stable compartments; the third rate is probably a reflection of excretory processes, principally urinary. A comparison of these curves with those for sodium shows some differences, especially in the portion of the curves dependent upon the excretion of the isotope.

1082 The depressive effect of desiccated thyroid on I^{131} metabolism: a preliminary report. J. O. Reed, K. E. Corrigan, and H. S. Hayden. *Harper Hosp. Bull. 7*, 236-9(1949) May-June.

The metabolisms of seven patients were studied through the use of radio-iodine during and after dessicated thyroid administration. Radio-iodine (I^{131}) was given in 50 mc tracer amounts to adults and in smaller amounts to children, and the collection of the tracer in the thyroid and its excretion in the urine were then measured. The measurements were made during and after the administration of the dried gland in the amounts of 0.5-6 g daily for 1-24 months. A definite inhibition of I^{131} metabolism was observed in all the cases and was reflected by either a marked decrease in the thyroid uptake of the tracer with a relatively small variation from normal in urinary excretion or little decrease in gland uptake with a large decrease in urinary excretion. The findings suggest a division of the patients into two groups and the possible utilization of these studies to determine the presence of hypothyroidism.

1083 Studies on the metabolism of radioisotopes by various fungi and bacteria--the distribution of organisms containing radioiodine (I^{131}) in the animal body. I. A. Pearson, J. M. Hammer, K. E. Corrigan, and H. S. Hayden. *Am. J. Roentgenol. Radium Therapy 61*, 839-46(1949) June.

This paper deals with the distribution of I^{131} when the solutions administered consist of spores or bacteria grown in the presence of the isotope. The methods of preparation of the solutions are described. Fourteen dogs were used in a series of experiments which involved the administration of Alternaria spores, Fusarium, Oospora, Blastomyces, Actinomyces, Monilia, Histoplasma, Crytococcus, Sporotrichium, and Tubercle bacilli. The I^{131} was injected in doses of 20-1,000 mc and four of the animals were controls. In each case, the thyroids were examined for radioactivity, and the results were tabulated. The relative rates of destruction of nonpathogens were demonstrated by an increase in the radioactivity of the reticulo-endothelial system and an increase in radioactivity of the thyroid. The relative indestructibility of the pathogens as compared with the non-pathogens was illustrated by the retention of the radioactive tracer in the lesions of Blastomyces and Tuberculosis. The method described here, the authors state, can be used to follow the distribution and course of other pathogenic and non-pathogenic organisms administered intravenously which incorporate radioactive isotopes. 28 references.

BIOLOGY AND MEDICINE (continued)

1084 The utilization of carbon dioxide by the mature rat in the formation of fatty acids. Jack Schubert and Wallace D. Armstrong. *Science 108*, 286(1948) Sept. 10.

The results of investigations concerned with the positions of the isotopic carbon atoms in saturated and unsaturated fatty acids and the mechanisms involved are presented. Purified saturated and unsaturated fatty acids derived from previous experiments were analyzed by: decarboxylating the fatty acids in a stream of nitrogen, and collecting the evolved CO_2 in saturated $Ba(OH)_2$; and, converting the unsaturated fatty acids to their solid calcium salts before counting. The data show that the average amount of C^{14} atoms from the carboxyl portion of the saturated and total fatty acids is approximately twice as high as the average of all the carbon atoms present in the structures. The results also indicate that the C^{14} activity derived from CO_2 is also present on the odd carbon atoms of the fatty acids. It is stated that the mechanisms for this phenomenon can be derived from the relationships in the tricarboxylic acid cycle.

CHEMISTRY

1085 Determination of the number of double bonds in less-than-milligram amounts of unsaturated fatty acids by catalytic hydrogenation in the Warburg apparatus. James F. Mead and David R. Howton. AECU-301, Apr. 16, 1949. 13p.

Methods for the determination of the degree of unsaturation in fatty acids are discussed with special reference to their generality and applicability to small amounts of material. A method is described for determining the number of carbon-to-carbon double bonds in less than mg amounts of the methyl esters of oleic, linoleic, and linolenic acids, and of maleic anhydride. The method involves the use of the Barcroft-Warburg tissue respirometer to measure the extent of hydrogenation (catalyzed by Pd on charcoal) at atmospheric pressure and room temperature.

1086 Detection of lead in air with the aid of a Geiger-Müller counter. O. G. Koppius. *J. Optical Soc. Am. 39*, 294-7(1949) Apr.

An abstract of this article was published in *Analyt. Chem. 20*, 1127(1948) Nov. It was listed in Nuclear Science Abstracts as Abstract 2-59.

1087 Dosage of radiobromine in biological material by the method of mineralization with sodium peroxide in Parr's microbomb. Pascaline Daudel, Monique Flon, and Christine Herczeg. *Compt. rend. 228*, 1059-60(1949) Mar. 21 (in French).

The method of mineralization of organic tissues in Parr's microbomb for the dosage of halogens, Elek and Harte, *Ind. Eng. Chem. Anal. Ed. 9*, 502(1937); Elek and Hill, *J. Am. Chem. Soc. 55*, 2550, (1933), was applied for the dosage of radiobromine. A nickel bomb containing a mixture of 2 g sodium peroxide, 0.2 g KNO_3, 0.05 g sugar, 10 mg NaBr as a carrier, and 0.5-100 mg of dried animal material, was heated on a microburner for 10 min; the contents were dissolved in water and treated with $4N.HNO_3$ and $AgNO_3$; the activity of the precipitated radioactive silver bromide was measured with a Geiger-Müller counter. The experiments were made with livers, spleens, and hypophyses of mice injected with radiobromine-containing triphenylethylene. The results showed a satisfactory constancy of the specific activity in each kind of organ.

1088 Quantitative paper chromatography. Robert C. Brimley. *Nature 163*, 215-6(1949) Feb. 5 (Letter to the editor).

Fisher, Parsons, and Morrison, *Nature 161*, 764(1949), showed experimentally that a linear relation holds between the area of the spot of test substance and the logarithm of the concentration at which it is originally applied. Using this the author gives a theoretical derivation $A = \frac{4\pi Dt}{\log e - 4\pi Dt \cdot k}\left[\log C_i - \log c + \log\left\{1 - \exp\left(\frac{-a^2}{4Dt}\right)\right\} + f\right]$., where A is the area of the spot, C_i is the concentration at radius "a" at time t, D is a diffusion constant, k is a proportionality factor, f is the deviation from proportionality. The necessity of attaining the higher values of 2 Dt in experimental work is clear, as is the importance of keeping the initial area of the spots small and uniform. A table, graph, and practical example are included.

CHEMISTRY (continued)

1089 Remotely controlled equipment for separations by ion exchange. M. B. Hawkins, R. E. Garber, and E. R. Tompkins. AECD-2646, nd. Decl. July 13, 1949. 12p. For publication in NNES.

Ion exchange equipment designed to effect separation of six major fission products in concentrated, carrier-free solutions from pile-activated U is described. Sequences of three or four columns of sizes ranging from 6 liters to 6 ml are employed, the fission product cations being alternately absorbed and eluted from each. Delicate control of flow rates, acidity, and flow pattern, and measurement of radioactivity and volume, all by remote control are possible. All control operations are carried out from a central control unit. Provision is made for resin introduction and disposal, and for packaging the product solutions in portions of known volume and activity.

1090 Attempted preparation of a trivalent thorium compound. J. C. Warf. AECD-2654, May 27, 1947. Decl. July 14, 1949. 8p.

The literature on the existence of a second rare-earth series is reviewed, with a brief discussion of the electron configurations of Th and neighboring elements. The absence of a tripositive oxidation state of Th suggests that the elements of atomic number of 91 and beyond constitute a "thoride" series rather than an "actinide" series. Evidence on this point was sought by attempting to prepare ThF_3 by the reduction of the tetrafluoride with the metal, employing a technique successful in the case of UF_3. X-ray analysis showed no new phase was formed, and all results were negative.

1091 Micro-synthesis with tracer elements. II. Methyl-di(beta-chloroethyl)-amine hydrochloride (nitrogen mustard) and methyl bromide labeled with C^{14}. W. W. Foreman, Arthur Murray, III, and Anthony R. Ronzio. AECU-360, nd. 7p. Proposed for publication in *J. Org. Chem.*

Methanol labeled with C^{14} was converted to methyl bromide using concentrated HBr. The methyl bromide was then condensed with diethanol amine using a mole ratio of halide to amine of 1:5. When 1:1 mole ratios were used an appreciable amount of the amine was converted to the quaternary ammonium salt instead of the desired tertiary amine. The tertiary amine produced was halogenated with thionyl chloride to give methyl-di(β-chloroethyl) amine hydrochloride labeled with C^{14} in the methyl group. The yield based on methanol was 52.5%. The product obtained possessed an activity corresponding to 5.3μc/mg. The experimental procedures used in the synthesis, and for recovering and purifying the product are discussed in detail.

1092 Synthesis of some molecules of biological interest, containing radioarsenic. Buu Hoï, Raoul Causse, Pascaline Daudel, Monique Flon, Dhristiane Hertzeg, Nguyen Hoan, and Antoine Lacassagne. *Compt. rend. 228*, 868-70(1949) Mar. 7 (in French).

In a previous work, *Bull. Soc. Chim. France 13*, 51(1946), the authors have shown a simple procedure of preparation of a very active $*As^{76}Cl_3$, according to $*As_2S_3 + 3S_2Cl_2 \longrightarrow 2* AsCl_3 + 9S$. The sulfide $*As_2S_3$ was obtained by Szilard's method from sodium arsenate irradiated by slow neutrons in the cyclotron. In the present work $*AsCl_3$ was used in the synthesis of several biologically-interesting radioactive compounds: adamsite and its derivatives, atoxyl, arsacetin, and salvarsan. (Adamsite was used as a combat gas on account of its sternutative properties; one of the derivatives perpared is toxic for the skin; arsacetin causes auditory and equilibrium troubles; atoxyl and salvarsan are therapeutic agents for the treatment of trypanosomiasis).

1093 Emission spectra of vapors of water and heavy water excited in a discharge tube. Sydney Leach. *Compt. rend. 228*, 1006-7(1949) Mar. 21 (in French).

Following Schüler and Woeldike, *Physik. Z. 44*, 335(1943), the author studied the emission spectra of H_2O and D_2O which were obtained in a discharge tube provided with hydrogen cushions that prevented the vapors from reaching the electrodes and reduced thereby the chemical decomposition. The spectrum of H_2O consists of 55 lines between 18040 and 23709 cm^{-1}, arranged in six bands. The spectrum of D_2O has 93 lines between 18134 and 23567 cm^{-1}, in seven bands. In both cases all the bands are degraded towards the red. The rotational structures, moments of inertia, and constants of force are discussed.

CHEMISTRY (continued)

1094 Viscosity of deuterium oxide and water in the range 5° to 125°C. Robert C. Hardy and Robert L. Cottington. *J. Research 42*, 573-8(1949) June (See also Nuclear Science Abstract 3-295).

Measurements of the absolute viscosity of deuterium oxide of 99.5% purity and of water were made over the range 5° to 125°C. It is estimated that these determinations are accurate within 0.1% in relation to the value 1.0050 centipoise for the viscosity of water at 20°C. The work also included determinations of the density of deuterium oxide over the range 90° to 125°C. Values for the viscosity and density of 100% deuterium oxide were obtained by linear extrapolations. The ratio of the viscosity of deuterium oxide to that of water at the same temperature was found to be 1.3052 at 5°C. This ratio decreases at a diminishing rate with increase in temperature to a value of 1.1456 at 125°C.

1095 A study of the oxidation of potassium iodide in aqueous solution by ionizing radiations. Marc Lefort. *Compt. rend. 228*, 831-3(1949) Mar. 7 (in French).

Oxidation of potassium iodide in aqueous solution by x-rays and γ-rays, a reaction studied already by Lannuig and Lind, *J. Phys. Chem. 42*, 1229(1938); and Haissinsky and Lefort, *Compt. rend. 228*, 313(1949), was examined kinetically in its relation to radiation dose, the iodide concentration and the pH, by using photo-colorimetric measurements. Concentration equilibrium equations and corresponding experimental curves are given.

1096 An x-ray study of the rare-earth oxide systems: Ce^{IV}-Nd^{III}, Ce^{IV}-Pr^{III}, Ce^{IV}-Pr^{IV}, and Pr^{IV}-Nd^{III}. J. D. McCullough. AECU-370, June 16, 1949. 18p.

An x-ray study of the above systems has been carried out with the following results: Solid solutions with the fluorite structure are formed in all cases and lattice constants have been determined as a function of composition. For the oxide systems $M^{+4} - M^{+3}$ there is an upper solubility limit varying from 50 to 67 atomic per cent of the trivalent metal. Pr is readily oxidized to Pr^{+4} in the presence of Ce^{+4}, but with more difficulty in the presence of Nd^{+3}. In no case is there evidence for the oxidation of Pr beyond the +4 state, even under oxygen pressures as high as 50 atmospheres.

1097 The association of cerous ion with iodide, bromide, and fluoride ions. Stanley W. Mayer and S. David Schwartz. Naval Radiological Defense Laboratory Interim Report AD-128(C). June 7, 1949. 15p.

The theory for the measurement of the constants for complex formation between Ce fission product and halide ions has been reviewed. The distribution of Ce^{+3} between cation exchange resin and solutions of NaI, NaBr, NaF, and $NaClO_4$ was measured using Ce^{141} and Ce^{144} as tracers, and the constants for ion-pair formation between Ce^{+3} and the halides were calculated. The data for these experimental measurements are tabulated. From these data the formulae and association constants of the complexes have been calculated on the basis of the theory. The results agree qualitatively with previous observations on the behavior of halide ions.

1098 The infrared spectrum of $C^{14}O_2$. R. K. Sheline and J. W. Weigl. AECU-287, June 16, 1949. 4p.

A Perkin-Elmer automatic infrared spectrometer with a NaCl prism was used to obtain the spectrum of this CO_2 in the region 2-16μ. The measurements were made at room temperature in a 9.4 cm glass cell fitted with KBr windows. The total CO_2 pressure was 9.6 mm. The absorption curves are shown.

1099 Microwave spectroscopy at Y-12. A. L. Southern and G. W. Kielholtz. AECU-355, May 12, 1949. 10p.

The status of the microwave spectroscopy research program at the Atomic Energy Commission's Y-12 plant in Oak Ridge, Tennessee, is summarized. It has been chiefly directed toward the analysis of isotopic material. The design and assembly of the equipment used is briefly described. At the present time work on the analysis of N^{14} and N^{15} in NH_3 in order to establish the accuracy of microwave equipment is underway. A frequency standard which uses a 2K47 Kylstron as a multiplier is near completion. A Stark cell is being built, and in the future it is hoped that an automatic recorder can be perfected. A schematic diagram of a microwave spectrograph is included.

CHEMISTRY (continued)

1100 Alkaline earth polyuranates. H. R. Hoekstra and J. J. Katz. AECD-2647, June 1949. Decl. July 12, 1949. 6p.

The preparation of alkaline earth polyuranates is critically discussed. It appears that thermal decomposition of the double alkaline earth uranyl acetates provides the simplest approach to the synthesis of these compounds. MgU_2O_7 undergoes reversible decomposition at elevated temperatures. Equilibrium studies of this decomposition are described, and the phase relationships of this system are discussed. Preliminary observations on the dissociation of the Ca, St, and Ba compounds are also discussed. The work described is part of a general investigation of metal uranates and polyuranates. The material given here, however, includes only the diuranates of Mg, Ca, St, and Ba.

1101 A precise volumetric method for the determination of uranium in uranium oxides. W. Simon, I. Asbury, and V. E. Flanders. AECD-2652, Aug. 27, 1948. Decl. July 20, 1949. 21p. Proposed for publication in *Analyt. Chem.*

A volumetric procedure using ceric ammonium sulfate as the titrant has been developed for the analysis of U in relatively pure samples of uranium oxide with a precision of 0.05% of the U present. This procedure differs from the standard volumetric procedures only in the quality of the equipment and in the method of dissolving the samples. Techniques for sampling and weighing, solution of the oxide in hot concentrated H_2SO_4, reduction of sample in a Jones reductor, aeration procedures, titration of sample, reagent blank titration, miscellaneous sources of errors, standardization of ceric ammonium sulfate, indicator preparation, and details of the experimental procedure are discussed.

1102 The reaction between calcium hydroxide and uranyl nitrate solutions. Charles Tanford, R. L. Tichener, and H. A. Young. AECD-2653, Feb. 19, 1945. Decl. July 12, 1949. 15p.

This paper reports potentiometric titrations of $UO_2(NO_3)_2$ solutions with $Ca(OH)_2$, changes in the absorption spectrum during the titrations, conclusions about the hydrolysis of UO_2^{++} ion, observations on the precipitate formed, a study of its slow conversion to "calcium diuranate" and an investigation of the solubility of these various precipitates in calcium hydroxide solutions.

1103 The ionic absorption spectra of the uranium chlorides in a polar, aqueous solvent. C. C. Sterett and V. P. Calkins. AECU-352, Mar. 4, 1949. 11p.

The absorption spectra of the following U chlorides have been measured in water: UCl_3, UCl_4, UCl_5, UCl_6, and $UOCl_2$. All these chlorides were found to be soluble in water. Only two basically different spectra were shown by these chlorides, that of the UO_2^{+2} ion, given by UO_2Cl_2 and the UCl_6, and that of the U^{+4} ion, given by UCl_3 and UCl_4. UCl_5 clearly showed a combination of the two basic spectra. The existence of UCl_5 as a double compound of the UCl_6 and UCl_4 readily explains the spectra observed for UCl_5. Comparisons of these spectra have been made with those of various U halides in a polar, nonaqueous solvent such as methyl acetate.

ENGINEERING

1104 Performance data for high vacuum pumps. Walter H. Kohl. *Iron Age 164*, 59-63 (1949) July 28.

Seven tables are presented which give data on high vacuum pumps, including their performance characteristics, costs, manufacturers, greases, oils, fluids, and other pertinent information. In diffusion pumps the limiting pressure of the best unit is 2×10^{-7} mm of mercury. The data given on the best mechanical high vacuum pump has a limiting pressure of 0.1 μ.

MINERALOGY, METALLURGY AND CERAMICS

1105 The radioactivity of sediments. E. N. Tiratsoo. *Petroleum 12*, 61-5(1949) Mar. (See also NSA 2-246).

The γ-ray well-logging technique has established itself as a standard method of oil field investigation. Its theory and application were described in *Petroleum 11*, 1(1948). This article, based on original research, describes a laboratory method of estimating the radioactivity of rock samples which should prove of value in establishing oil field correlations, since the technique described may easily be used in the examination of bit cuttings. Previous laboratory determinations of radioactivity, utilizing ionization chambers and electroscopes, needed much larger amounts of rock.

1106 Growth and perfection of beryllium crystals. I. Growth of large beryllium crystals by solidification. Louis Gold. AECD-2643, nd. Decl. July 20, 1949. 32p. Proposed for publication in *Acta Cryst.*

This report describes the problems which arise in growing Be crystals by solidification and indicates progress made in the direction of achieving favorable results. Many of the problems stem primarily from the highly reactive nature of Be, and for this reason the metal should be free of insoluble impurities and volatile components. The effects of the possible existence of Be allotropes upon successful crystal production are pointed out. The growth of Be crystals has not followed the general pattern which is encountered with Cu, Au, Pb. However, in spite of the complexities, approximately 10% of the runs produced specimens which could be considered as virtually single crystals. In an appendix the thermodynamics of the reactions of Be at high temperatures in vacuo are considered. 22 references.

1107 Evaluation of the stiffness coefficients for beryllium from ultrasonic measurements in polycrystalline and single crystal specimens. Louis Gold. AECD-2644, nd. Decl. July 21, 1949. 25p. Proposed for publication in *Phys. Rev.*

The method employed for evaluating stiffness coefficients for beryllium is based upon compressional and shear wave velocities in polycrystalline metal, and compressional wave velocities in single crystal specimens having their crystallographic axes differently oriented with respect to the direction of propagation. Deriving coefficients from this information requires that the crystal belong to classes 21-27 of Voight's designation, thus having 5 independent constants, and that the crystal be not too anisotropic. The stiffness coefficients for Be were determined to be as follows: c_{11}, 30.8; c_{33}, 35.7; c_{44}, 11.0; c_{12}, -5.8; c_{13}, 8.7. These coefficients are compared with those for other hexagonal metals - Mg, Zn and Cd. The author concludes that the results are in conformity with a number of experimental facts and basic principles.

1108 Growth and perfection of beryllium crystals. II. Studies of crystal perfection. Louis Gold. AECD-2645, nd. Decl. July 21, 1949. 18p. Proposed for publication in *Acta Cryst.*

The rocking-curve approach has been applied, in a modified form to the task of studying the crystal texture of single crystals before and after certain surface treatment. Some supplementary studies involving Laue patterns and fractographs served to round out the general picture of crystal perfection in beryllium. The fact that beryllium single crystals proved to be markedly imperfect was not startling. It is significant that the rocking-curve technique was found to be ineffective for any quantitative evaluation of the degree of imperfection. Serious doubts as to the general applicability of this approach for measuring crystal imperfection quantitatively are raised. Evidence of phase transformation being at least a contributing element to the high degree of imperfection in beryllium is contained in (1) the effect of annealing in the Laue pattern, and (2) the appearance of a second phase in the slip bands on the fractographic photomicrograph. 19 references.

MINERALOGY, METALLURGY AND CERAMICS (continued)

1109 The beryllium-iron system. R. J. Teitel and Morris Cohen. *J. Metals* 1, 285-96(1949) Apr.

The alloys of beryllium and iron, primarily from the standpoint of the equilibrium diagram are discussed. The apparatus and procedure necessary for preparing the various alloys is presented. The structures of the phases were studied by standard x-ray diffraction procedures. Most of the solid solubility limits were determined by the lattice-paramenter and disappearing-phase methods. Diagrams of the beryllium-iron system, several x-ray diffraction patterns, 11 photomicrographs, and 8 references are included.

1110 Ferromagnetism at very high frequencies. Method of measurement and process of magnetization. M. H. Johnson and G. T. Rado. Naval Research Laboratory Report NRL-R-3359, Sept. 22, 1948. 38p.

A method for measuring the complex permeability, μ, of a ferromagnetic metal is described. The determination of both components of μ is accomplished by a simultaneous measurement of the changes in attenuation and phase velocity introduced into a conducting system by the ferromagnetism of one of its walls. An experimental technique involving pulsed magnetic fields is used. Values of μ for samples of magnetic iron at 200 and 975 Mc as a function of a polarizing magnetic field (which is parallel to the high-frequency field) are compared to the static incremental permeabilities measured on the same sample. The interpretation of the experimental results indicates several characteristics of the magnetization in iron: the upper limit of domain dimensions in polarizing fields less than 500 oersteads is 10^{-4} cm; "weak-field-domain" wall displacements are practically eliminated at the frequencies used; spin rotation and "strong-field-domain" wall displacements are only slightly damped, and contribute to the magnetization in weak as well as in strong fields. Studies of hysteresis phenomena are discussed, and results on two types of permalloy presented.

1111 Oxidation-resistance of high melting point alloys. O. Kubaschewski and A. Schneider. *Can. Metals and Met. Inds.* 12, 16-17, 22-23, 26, 28(1949) July.

A similar article by the authors was published in *J. Inst. Metals* 16, 403-16(1949) Feb. It was listed in Nuclear Science Abstracts as Abstract 2-2127.

1112 Production of beryllium. "Degussa." W. B. C. Perrycoste. British Intelligence Objectives Sub-Committee Final Report BIOS-FR-319, Nov. 13, 1945. 13p.

A general description is given of the Be production plant of the Deutsche Gold and Silver Austalt located in Frankfurt, Germany. The steps in the production of $BeCl_2$ from beryl are outlined, and the electrolysis of the chloride to produce Be metal is discussed. A production flow sheet and a schematic drawing of the electrolysis furnace are included.

1113 Titanium--its prospects-- its properties. R. I. Jaffee and I. E. Campbell. *Iron Age* 164, 48-51(1949) July 28.

The authors discuss the prospects and properties of titanium and its alloys. Metallurgical concepts in alloying and high temperature application of the material are presented. A graph showing the comparison of short time elevated temperature tensile tests of titanium with 24ST extruded aluminum and 18-8 stainless steel is included. The field of usefulness of titanium at elevated temperatures is intermediate between that of aluminum alloys and true high-temperature alloys. From creep test results this range is approximately 400° to 800°F.

1114 Uranium^{235} in thucholite. J. B. Orr. *Phys. Rev.* 76, 155(1949) July 1 (Letter to the editor).

Tabulated data on the number of fission counts per minute have been obtained for samples of the radioactive minerals uraninite and thucholite, using both and air counter and an ionization chamber. The average values obtained were 0.44 ± 0.07 cts/min. for the uraninite, and 0.19 ± 0.05 cts/min. for thucholite. Since the thucholite sample is apparently of igneous origin and contains considerable carbon, it is suggested that (assuming it had originated from a mass of sufficient size) the carbon acting as a moderator of fission neutrons might have facilitated a chain reaction at one time. If such was the case, there might exist (as compared with normal uranium) a difference in the amount of U^{235} fissionable by slow neutrons. The author concludes that the results obtained warrant further investigation in order to obtain data which are more complete and accurate.

PHYSICS

1115 Angular distribution of 10.8 Mev deuterons scattered by deuterons. E. J. Stovall, Jr., J. C. Allred, K. W. Erickson, and J. L. Fowler. AECU-368, nd. 1p. Proposed for publication in *Bull. Am. Phys. Soc.*

This document is in abstract form; it is reproduced below in its entirety.

Cross sections for the elastic scattering of deuterons by deuterons have been measured for incident energy of 10.8 Mev at laboratory angles from 17.5° to 57° at 2.5° intervals. The deuteron beam from the Los Alamos cyclotron was focused on a thin gas target containing deuterium, and the scattered deuterons were detected in a proportional counter. A selsyn controlled foil shutter mounted in front of the counter prevented He^3 and H^3 at angles greater than 40° from entering the counter. H^1 and H^3, at the smaller angles, were discriminated against by using a ten-channel pulse amplitude analyzer. Typical values of the elastic scattering cross section at 10.8 Mev, in barns per unit solid angle, are given in the table for several angles in the center of mass system. The standard error of these values is estimated to be 3%. The experimental curve is symmetrical about 90° in the center of mass system.

θ	35°	40°	50°	60°	70°	80°	90°
σ	0.283	0.235	0.158	0.127	0.109	0.099	0.094

1116 The temperature of interstellar matter. II. Lyman Spitzer, Jr. *Astrophys. J. 109*, 337-53(1949) May.

The processes which tend to dissipate the kinetic energy of interstellar particles are discussed, and the rate of energy loss for each process is derived in a form suitable for numerical computation of interstellar temperatures. The phenomena considered are: free-free emission by electrons in encounters with protons and H atoms; inelastic encounters of electrons with atoms and with H_2 molecules; excitation of rotational states of H_2 molecules by encounters with H atoms and with H_2 molecules; and inelastic collisions of H atoms and H_2 molecules with solid grains. Application of these and previous results to the analysis of interstellar temperatures will be made in a subsequent paper.

1117 An upper limit to the electron density near the earth's orbit. Fred L. Whipple and Joseph L. Gossner. *Astrophys. J. 109*, 380-90(1949) May.

Brightness and polarization observations of the zodiacal light are used to determine the upper limit of the interplanetary electron density at one astronomical unit. The value depends on the assumed distribution law of the electrons, a 1/R law giving 800/cm^3; 1/R^3, 1000/cm^3. It is further shown that the observed polarization can probably be accounted for by reflection of sunlight by dust particles. Hence the upper limits for the electron density are probably much greater than the actual value. Certain consequences of these results are discussed briefly.

1118 Notes on cosmic ray conference, September 10-12, 1947. Edited by W. T. Scott. AECU-282, Sept. 1, 1948. 55p.

The notes have been issued in the hope that a useful summary of the 1947 status of cosmic ray research will be provided. The subjects of the various notes include primaries in cosmic rays, theory of cosmic ray mesons, and meson capture decay and properties. Individual notes composing the document are: Review of the evidence for primary protons, by T. H. Johnson; Results of some V-2 cosmic ray experiments, by R. P. Peterson; Rocket experiments at the Naval Research Laboratory, by G. J. Perlow; Recent results from balloon experiments, by G. Snow; The interaction of cosmic primaries with interstellar radiation, by E. Feenberg; Production of mesons, by J. R. Oppenheimer; Interaction of mesons with nuclei, by H. A. Bethe; The two meson hypothesis, by R. E. Marshak; Capture and decay experiments, by O. Piccioni; Meson decay observations, by G. E. Valley; Three experiments on meson decay, by R. Sard; Evidence from photographic plates, by E. O. Salant; Nuclear scattering of mesons, by R. P. Shutt; Correlated probabilities in multiple scattering, by W. T. Scott.

1119 The energy spectrum of cosmic-radiation particles and photons. J. Clay. *Revs. Modern Phys. 21*, 82-93(1949) Jan.

A similar article by the author was published in *Physica 14*, 574-96(1949) Jan. It was listed in Nuclear Science Abstracts as Abstract 2-1904.

PHYSICS (continued)

1120 Exchange phenomena of the nucleons that generate penetrating showers. H. A. Meyer and G. Schwachheim. *Phys. Rev. 76*, 149(1949) July 1 (Letter to the editor).

The recently reported measurements of Cocconi, *Phys. Rev. 75*, 1074(1949), on the absorption of ionizing and penetrating shower-producing radiation, which are not compatible with the exponential absorption which had been verified by Tinlot and Gregory, *Phys. Rev. 75*, 519(1949), and others, are discussed, taking into account a fundamental difference, due to the geometry, which would affect the counting in the experiments of Cocconi. It is demonstrated that the exchange properties of the penetrating, shower-producing radiation explain the discrepancy.

1121 On local production of mesons at 3500 m altitude. Bernard d'Espagnat and Charles Peyrou. *Compt. rend. 228*, 674-6(1949) Feb. 21 (in French).

The formation of μ-mesons in photographic plates suspended in the laboratory of Jungfraujoch (3500 m) at 2 m above the floor, as described by Camerini, et al., *J. Optical Soc. Am. 32*, 247(1942), is interpreted as due to a stream of π-mesons coming from the floor and disintegrating into μ-mesons; the π-mesons are created in the floor as a result of collisions between nucleons and primaries coming from above. From the value 35 Mev for the average energy of the observed μ-mesons, and by assuming that the average energy of the parent π-mesons has the same value, the authors calculate that the energy of the primary should be at least 570 Mev, if the angle between the primary ray and the emitted meson is 180°; the energy of mesons emitted at 0° is 290 Mev.

1122 A probable sidereal variability of extensive cosmic-ray showers. Pierre Auger, Jean Daudin, Jean Denisse, and Alice Daudin. *Compt. rend. 228*, 1116-8(1949) Mar. 28 (in French).

Measurements on extensive showers made on the Pic du Midi (Pyrenees) in August-October 1948, revealed in the curves the existence of a certain periodic pattern, the period being the sidereal day. The curves present hourly systematic deviations exceeding the triple value of the probable error. The showers were registered by coincidences in three groups of counters, of which one was separated from the other two by a distance varying from 5 to 75 m. Maze counters filled with methylal were used. The showers measured in these conditions descend from primaries whose energy is of the order of 10^{15} ev. This high energy value makes them almost independent from any electromagnetic influences, so that a certain tendency to preserve the original emission direction can be expected. The details of the curves show correspondences with the distribution of galactic noises coming from different stellar regions. There is a minimum coinciding with the minimum of the galactic noise between 9 and 12 h sidereal time, when, at the observation point, the culminating region was that, poor in stars, which lies between the constellations of Perseus and Ursa Major. A maximum and a steady up-slope in the curves correspond to the culmination of the rich galactic regions of Cygnus and the Sagittarius.

1123 An indicating fluxmeter utilizing a germanium semi-conductor. H. E. Walchli. AECU-289, Apr. 19, 1949. 17p.

An indicating fluxmeter using a slab of germanium metal as the sensitive element is described. This instrument can be used for directly reading on a meter the flux density of any magnet with fields ranging from 100 to 10,00 gauss or more. Results of laboratory tests on the instrument indicate output to be linear with exciting current and field strength, and inversely linear with temperature over limited ranges. Results of comparisons with a normal flip-coil fluxmeter are reported and indicate an accuracy of approximately 50 gauss throughout the range of the instrument when temperature compensating devices are incorporated in the circuit. The instrument uses the Hall Effect in the metal as a basis of operation.

1124 Vibrationless galvanometer support (final report). D. L. Haas, J. R. Parks, and J. F. Eichelberger. AECU-348, Mar. 2, 1949. 12p.

A galvanometer support has been designed for use in laboratories where there are no piers to ground on which to mount a high sensitivity galvanometer and where penetration of the electrostatic shielding cannot be tolerated. The following features have been incorporated in the design: The natural period of the galvanometer support is short compared to the natural period of the galvanometer. This prevents resonance between the support and the galvanometer, and also prevents the galvanometer from being affected by harmonics in the motion of the support. The center of gravity of the support coincides with the center of gravity of the galvanometer. The natural period of the supporting rods is compared to the period of any forced vibrations that

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might be encountered. Friction is provided to damp any vibrations that might be set up in the suspension of the support. Detailed specifications for the support are given, and its design and construction are discussed. A schemetic diagram and photograph of the support are included.

1125 Circuit and constructional details of the precision electronic pH control system. J. E. Breeze. National Research Council of Canada Report ERA-166 (NRC-1889). Feb. 1949. 67p.

A complete precision pH control system suitable for laboratory use is described. The system makes possible pH control of biological fermentations to an accuracy of 0.01 pH intervals, and pH measurement or comparison to an accuracy of 0.002 pH intervals. A general description of the control system, constructional details and principles of operation of the pH monitor, a functional description of the circuit and its operation, a detailed description of the circuit stage by stage, and a description of the power supply are given.

1126 Comparative survey of ion guns--III. Max Hoyaux and Ignace Dujardin. *Nucleonics 5*, 67-71(1949) July (See also Nuclear Science Abstract 3-392).

In this last of a series of three papers, the necessary refinements for good ion-gun design and focusing are discussed.

1127 The illuminating system of the electron microscope. James Hillier and S. G. Ellis. *J. Applied Phys. 20*, 700-6(1949) July.

Using a self-biased electron gun, the current arriving at the specimen, the current density at the specimen, and the area of illumination of the specimen have been determined for different values of the filament height. The variation of current density at the specimen with angular aperture of illumination has been determined and the results compared with those for the zero-biased gun. The performance of the self-biased gun is assessed and some of the factors involved in its operation and maintenance are discussed.

1128 Table of isotopes of the heavy elements and their genetic relationships. Karl E. Zimens. *Svensk Kem. Tid. 61*, 15-7(1949) (in Swedish).

Most of the data given in this table has appeared in a previous publication by Seaborg and Perlman, *Revs. Mod. Phys. 20*, 585(1948) Oct. It was listed in *Nuclear Science Abstracts* as abstract No. 1-1838.

1129 Direct calorimetric study of fission product decay in active slugs. R. A. Day and C. V. Cannon. AECD-2642, nd. Decl. July 13, 1949. 15p. For publication in NNES.

The radioactive energy output of U slugs from the Clinton pile was measured in a calorimeter. Irradiation periods extended from 1 day to 122 days, and decay time from 30 minutes to 60 days after discharge. Correction was made for radiation not absorbed in the calorimeter. The results have been calculated to watts per gram of fission product produced, and are compared with previously reported data.

1130 The scattering of slow neutrons by paramagnetic crystals. I. W. Ruderman. AECD-2650, Apr. 17, 1949. Decl. July 12, 1949. 40p. Proposed for publication in *Phys. Rev.* (See also Nuclear Science Abstract 2-525).

The paramagnetic scattering of neutrons by anhydrous crystals of MnF_2, MnO, and α-Fe_2O_3 was studied, using slow neutron transmission data obtained with the Columbia slow neutron velocity spectrometer. Details are given of the experimental arrangement, which permits measurements to be made with neutrons having wavelengths up to 6.4 A. The paramagnetic cross section, σ_{pm}, may be separated from the total cross section in regions where there are no interfering crystal diffraction effects. Large values of σ_{pm} were found for the manganous compounds, but no paramagnetic scattering by α-Fe_2O_3 was observed. The results are compared with the theoretical predictions of Halpern and Johnson, *Phys. Rev. 51*, 992(1937); *Phys. Rev. 52*, 52(1937); *Phys. Rev. 55*, 898(1939). The dependence of σ_{pm} on the neutron wavelength was determined, and is compared with a theoretical form factor based on purely elastic scattering. 33 references. This report is a revision and amplification of AECD-2462.

PHYSICS (continued)

1131 Yield of 6.8d U^{237} in pile-irradiated uranium. William Rubinson, A. Turkevich, H. Finston, C. W. Stanley, A. W. Adamson, and W. B. Leslie. AECD-2649, nd. Decl. July 13, 1949. 4p. For publication in NNES.

The amount of 6.8d U^{237} produced by (n, 2n) reaction on ordinary U^{238} has been determined for the graphite pile at Clinton by several workers. The "fission yield" seems to be about 0.2% in the metal slugs and perhaps a little lower in samples placed in the graphite moderator.

1132 Total reflection of neutrons. Morton Hamermesh. AECU-270, May 12, 1949. 20p.

The discussion is based on assumptions that the propagation of neutrons through a material can be characterized by the index of refraction, n. It will, therefore, exhibit all the typical phenomena of optics, like bending at an interface, and total reflection. From a microscopic viewpoint, the deviation of the refractive index from its vacuum value can be described in terms of the superposition of the incident wave and the waves coherently scattered in the forward direction from the individual atoms. Fluctuations in density (for example, in a gas) will add a diffuse background. For crystals there will occur also coherent scattering at Bragg angles; but the refraction can still be described in terms of the forward scattering into the zero'th order. The coherent amplitude will consist in general of a sum of terms: nuclear and magnetic. Also, in an absorbing medium the propagation vector will be complex, and the absorption will affect the value of the refractive index. 12 references.

1133 Experimental corroboration of the theory of neutron resonance scattering. R. K. Adair, C. K. Bockelman, and R. E. Peterson. AECU-358, nd. 6p.

Detailed theoretical investigations have been made on the variation of the cross section with energy near a neutron scattering resonance, and the phenomenon of destructive interfence between resonance and potential scattering has been predicted. While measuring the total cross section of S, a resonance was observed which clearly shows the effect predicted by theory. Cross sections were determined by transmission measurements using monoenergetic neutrons from the Li(p,n) reaction over an energy range from 16 to 250 kev. At 111 kev there is a sharp peak preceded by a dip which is interpreted as caused by destructive interference between resonance and potential scattering. Since at this energy less than 2% of the potential scattering is due to neutrons of more than zero angular momentum, it is concluded that the resonance is caused by S-neutrons forming a state of S^{33} with spin 1/2 from S^{32} which has an isotopic abundance of 95% and spin zero.

1134 Derivation and integration of the pile-kinetic equations. Henry Hurwitz, Jr. *Nucleonics* 5, 61-7(1949) July.

In calculating the power level of a chain-reacting system as a function of time when certain changes are made in the reactivity it is customary to make use of the so-called "pile-kinetic" equations. These are a set of coupled differential equations involving the power level of the pile and the number of "excited nuclei" whose decay gives rise to delayed neutrons. Some of the methods are described which can be used to solve the pile-kinetic equations. In particular a general solution is obtained for the case where the reactivity does not vary too rapidly with time. A careful derivation of the pile-kinetic equations is also given for a general assembly in order to show the assumptions which are implicit in the equations, and the limits of their validity.

1135 Introduction to the theory of diffusion and slowing down of neutrons--III. R. E. Marshak, H. Brooks, and H. Hurwitz, Jr. *Nucleonics* 5, 53-60(1949) July (See also Nuclear Science Abstract 3-773).

The authors discuss the age theory by considering the derivations of both the Boltzmann and age equations. In Parts I and II, *Nucleonics* 4, No. 5, p. 10, and 6, p. 43 (1949), the authors discussed the Boltzmann equation in connection with the diffusion theory.

1136 (n,2n) cross sections. B. Cohen. Carnegie Institute of Technology Department of Physics Technical Report No. 2, nd. 22p. (NP-966).

Relative cross sections of (n, 2n) reactions were obtained by bombarding samples with neutrons and measuring the induced β activity. The neutrons were obtained by bombarding an internal thick beryllium target with 17-Mev deuterons from the University of Pittsburgh cyclotron. Non-metallic samples were in the form of 1-1/4-inch diameter pills pressed from powders of suitably chosen compounds. Metallic samples were rolled to various thicknesses, cut to the shape of pills, and

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exposed. After bombardment for a suitably chosen length of time, the pills and monitors were placed in aluminum pans and their decay measured with a thin window end counter. Activities found for the (n,2n) reaction with F^{19}, P^{31}, N^{14}, Sb^{121}, C^{12}, Zn^{64}, Ag^{107}, O^{16}, Cu^{63}, Fe^{54}, Cr^{50}, and K^{39} are reported. Determination of the neutron spectrum, interpretation of results, absolute cross sections, and thresholds for the reactions considered are discussed.

1137 On the energy loss by fission fragments along their path. N. O. Lassen. *Phys. Rev.* 75, 1762-3(1949) June 1 (Letter to the editor).

Further results, *Phys. Rev.* 70, 577(1946), on the specific ionization of fission fragments as measured using a shallow ionization chamber are reported. It was found that with hydrogen the extrapolated portions of the ranges are considerable smaller than the values previously obtained in chamber measurements, Bøggild, Arrøe and Sigurgeirsson, *Phys. Rev.* 71, 281(1947). Thus, while the curves in H_2 and D_2 coincide over the first part of the range, for lower velocities a splitting occurs. In a discussion of the results it is shown that they are consistent with theoretical considerations since for fragment velocities less than $v_0 = e^2/\hbar$ electronic stopping becomes practically zero.

1138 Preparation and use of neutron sources. K. J. McCallum. *Nucleonics* 5, 11-21(1949) July.

The most common α-neutron source is radium-beryllium. Also used are polonium sources, which have the advantage that they emit only weak γ-radiation. Properties of photoneutron sources are tabulated. In using neutron sources containing radium, protection of personnel against γ-radiation is more important than against neutrons.

1139 The scattering of high-energy neutrons by protons and the law of interaction between nucleons. E. H. S. Burhop and H. N. Yadav. *Proc. Roy. Soc. (London)* 197*A*, 505-23 (1949) July 7 (See also Nuclear Science Abstract 2-534).

Calculations have been carried out of the angular distribution and total collision cross-section to be expected in the case of the scattering of neutrons of energy in the range 83 to 250 Mev by protons. Born's approximation has been used in these calculations, and a large variety of possible shapes and ranges for the radial variation of the interaction potential have been investigated. For each case the radial variation of the central and non-central parts of the interaction was taken to be the same. The exchange properties of the interaction should be capable of deduction from the general shape of the angular distribution of the scattering curves. Potentials of the exponential and Yukawa type, however, show a greater concentration of the scattering into angles near 0 and 180° than is the case for a spherical well interaction. The total collision cross-section depends quite markedly both on the exchange properties and radial variation of the interaction. Closest agreement with the measurements of total cross-section for 90 Mev neutrons are given for a symmetrical interaction with a radial variation in the form of a Yukawa potential of range 1.18×10^{-13} cm., although this interaction predicts too large a value for the ratio of the differential cross-section at 180° to that at 90°.

1140 Magnetic moments of deuterium-2, lithium-7, and fluorine-19. Kai Siegbahn and Gunnar Lindstrom. *Nature* 163, 211(1949) Feb. 5 (Letter to the editor).

The authors have constructed an apparatus utilizing the small natural line-widths obtainable with the magnetic resonance absorption method or nuclear induction method for the precision measurements of nuclear magnetic moments. A brief description of the apparatus is given. For the detection of the resonances, the balance method was used. These were first proposed and used by Purcell, Torrey and Pound, *Phys. Rev.* 69, 76(1946). The determinations of the nuclear magnetic moments of D^2, Li^7, and F^{19} are summarized in three tables. All moments are expressed in the proton moment as a unit. The results obtained are given below: for D^2, $\mu D/\mu P = 0.3070183 \pm 0.0000015$; for Li^7, $\mu Li^7/\mu P = 1.165833 \pm 0.000050$; and for F^{19}, $\mu F^{19}/\mu P = 0.940934 \pm 0.000015$.

1141 Nuclear spin of Fe^{57}. M. Gurevitch and J. G. Teasdale. *Phys. Rev.* 76, 151(1949) July 1 (Letter to the editor).

The spectrogram of a 29 mg sample of iron enriched in the isotope Fe^{57} has been examined. As in the case of many elements having an odd atomic mass number and an even nuclear charge it was found that this isotope has no measureable magnetic moment, as a hyperfine structure was not detected.

1142 On the systematics of nuclei. André Broniewski. *Compt. rend.* 228, 916-8(1949) Mar. 14 (in French).

Stable elements of odd Z, when plotted on a N-Z diagram, present echelonned parallel straight lines which have a slope 1 until Z = 41, then a slope 2 for Z > 41; the echeloning shows the corresponding stable isotopes. Besides these lines, there are horizontal and vertical lines of the

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"magic numbers" of 20, 50, 82, and 126 neutrons and protons, Mayer, *Phys. Rev.* 74, 235(1948). The relative position of all these lines is discussed, as well as their significance in the appearance of radioactive properties in certain isotopes (Z = 43 and 61, Rb87, K40).

1143 Instruction notes for 184-inch cyclotron deflector high voltage pulse generator model IV (2L7044), trigger amplifier (2L6952), deflector regulator (2L6974), regulator delay (2L6932), and deflector power supply (3Z1574). R. F. Edwards and H. M. Owren. AECU-350, June 14, 1949. 19p.

The report outlines the theory of operation and gives detailed circuit descriptions of the above auxiliary components of the 184-in cyclotron. Maintenance notes are given for the pulse generator and trigger amplifier. A schemetic diagram of the basic pulse generator circuit and 8 photographs of the equipment are included.

1144 184-inch cyclotron data. C. W. Park. AECU-351, Apr. 1, 1949. 17p.

The report tabulates operating data for the 184-in. cyclotron at the University of California Radiation Laboratory.

1145 Operation of the 184" cyclotron. L. R. Henrich, D. C. Sewell and J. Vale. AECU-354, May 17, 1949. 46p.

The report presents operational data in more detail than has been previously reported. Normal acceleration of ions, oscillations about the synchronous orbit, operation under normal conditions, loss of beam at large radius, coupling between free radial and vertical oscillations for the resonance value n = 0.2, coupling between the vertical oscillations and azimuthal in homogeneities in the magnetic field at n = 0.25, coupling between vertical and radial oscillations at n = 0.1, variation of ion current with voltage and with condenser speed, efficiency of acceptance time and as a function of rate of frequency modulation are discussed. Tank pressure, vertical focusing, oscilloscope data, width of beam on probe amplitude of free radial and vertical oscillation, and displacement of the center of rotation of the ions from the center of the magnet are also considered.

1146 The Berkeley electrostatic generator. C. M. Turner, A. J.Hudgins, F. L. Fillmore, M. R. Jeppson, and J. D. Gow. AECU-369, June 16, 1949. 34p.(See also MDDC-1474).

A pressure-insulated electrostatic generator has been built to serve as an injector of 4-Mev protons into the linear accelerator. This machine is of the Wisconsin horizontal type and is housed in a pressure vessel 8 ft in diameter and 27 ft long, designed for a maximum operating pressure of 200 psi gauge. A length of 15 ft is provided for the insulating support structure, including charging belt and accelerating tube. The air gap between the high potential electrode and tank wall is 20 in., with a second electrode operating at one-half the total voltage subdividing this gap into two 10-in. gaps. Dependable operation at the 4 million volt level is realized with 100 psi gauge nitrogen with about 5% by weight of Freon 12 (CCl_2F_2). Proton pulses at 4 Mev of up to 1 ma height and 500 μsec duration at a normal repetition rate of 30/sec are now available focused into a spot diameter of 1/16 in. - 1/8 in. The pulse repetition rate can be increased to give an average proton beam current of about 50 μamp.

1147 Conductivity changes in dielectrics during 2.5 Mev x-radiation. F. C. Armistead, J. C. Pennock, and L. W. Mead. AECD-2641, nd. Decl. July 19, 1949. 3p. Proposed for publication in *Phys. Rev.*

Preliminary conductivity measurements have been made on three plastic dielectrics during irradiation by 2.5-Mev x-rays. A potentential difference was applied across the sample being measured and the resultant current measured with an FP54 electrometer tube and Penick type bridge circuit. The conductivity of polyvinyl chloride was found to increase very rapidly upon the start of irradiation and to reach quickly an equilibrium value, approximately 30 times the original conductivity at an irradiation rate of 400 r/min, which was dependent on irradiation rate. Upon stopping the irradiation, the recovery was half complete in 30 min, nine-tenths complete in 16 hr. With vinylidene chloride the conductivity increased slowly over a period of about 2 hr (2.7×10^5 r total irradiation at 2000 r/min.) until it was about three times the original conductivity. The initial recovery rate was much lower than for polyvinyl chloride. A preliminary measurement on a sample of polystyrene showed that after a total irradiation of 5500 r at 1000 r/min, the conductivity had not risen to as much as 2×10^{-17} (ohm-cm)$^{-1}$. Assuming an initial conductivity of 10^{-20} (ohm-cm)$^{-1}$, the change was by less than a factor of 2×10^3. This result is in contrast to the report by Farmer, *Nature 150*, 521(1942), of a change by a factor of approximately 10^7 after a total irradiation of

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only 4000 r. The fact that the dielectrics become conducting during irradiation is to be expected by a mechanism such as that described by Mott and Gurney, whereby the passage of primary current (due directly to absorbed photons) changes the dielectric in such a way as to reduce the electrical barrier at the electrode-dielectric interface.

1148 The structure of atoms and atomic energy. L.. de Broglie and others. Hermann and Company, Paris, 1948. 144p. (in French).

A series of eight talks given by different speakers in Paris are presented in this book, destined for a reader with a college-level background. The following are the titles of the lectures: The structure of atoms and atomic energy, by Louis de Broglie; The atoms of the chemists, by René Dubrisay; The contribution of spectroscopy, by M. R. Lennuier; The contribution of wave mechanics to our knowledge of the atom, by R. Daudel; Transmutations and corresponding radiations, by I. Joliot-Curie; Systematics of atomic nuclei, by M. de Broglie; Contribution of cosmic-ray studies to nuclear physics, by L. Leprince-Ringuet; Nuclear fission and atomic energy, by Francis Perrin.

1149 Statistical methods used in the measurement of radioactivity. Some useful graphs. Alan A. Jarrett. AECU-262, June 17, 1946. 63p.

The statistical aspects of radioactive counting are discussed with reference to estimation of the accuracy of counting rate determinations, and description of counting procedures which will minimize errors due to the random variations in radioactive disintegration rates. Tables and graphs have been prepared as aids to the calculation of the magnitude of these variations and are included in the report. In addition to the fluctuations expected in the counting rate of a radioactive sample due to the random nature of the disintegration process, other variables affecting the counting rate which tend to increase the actual error made in a counting rate determination are reported. Methods of determining the presence of this additional error are described. 14 references.

1150 Detection of neutrons with scintillation counters. Robert Hofstadter. AECU-285, Nov 1, 1948. 6p.

Slow neutron detection with scintillation counters has been examined experimentally using the following methods of investigation. 1. (a) Detection of single gamma rays following capture by cadmium or mercury. (b) Detection of more than one gamma ray by observing coincidences after capture. 2. Detection of heavy charged particles after capture in lithium or boron nuclei. Method 1(a) serves moderately well for neutron detection but is limited to those cases where γ-ray background is small. Method 1(b) has not been pursued in detail since the number of coincidences for source strength used is only of the order of 1 every 5 sec. For Method 2 the following phosphors have been tried: ZnB_2O_4; LiCl with Tl impurity; NaI-LiCl with Tl impurity; NaI-boric acid with Tl impurity; NaI-$Na_2B_4O_7$ plus Tl; fused boric acid and ZnS(Ag). With the exception of the last phosphor most of the results so far have been negative, chiefly because the addition of impurity makes the fused mass nearly opaque. Fused boric acid-ZnS(Ag) phosphor is successful in that it permits neutron detection with little competing background. The use of anthracene for fast neutron counting is being investigated. In the 1.0-Mev range the results have not been particularly good.

1151 Portable alpha counter. Mark 1 Mod. 41B. C. Wesenberg. AECU-349, Mar. 31, 1949. 10p.

The counter operates in the proportional region which makes possible only the detection of α particles. Earphones are incorporated into the instrument for ease of radiation detection and to distinguish authentic and spurious readings. A light and flexible detector is obtained by building the probe separate from the circuit. The following components are discussed and evaluated in detail: condensers, insulators, batteries, and tubes. Problems remaining to be solved before the instrument is suitable for commercial production are discussed.

1152 Design and application of a logarithmic amplifier. C. W. Johnstone. AECU-363, nd. 4p.

This device, in which the output voltage or current is proportional to the logarithmic of the input current, can be used to serve the following functions in connection with nuclear reactors used for research purposes: (1) the provision of a continuous and uniformly accurate indication of the power level of the reactor, where an indicator with a linear response must be switched

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over several degrees of sensitivity to cover the entire range; (2) it may be incorporated in a safety circuit which will automatically take the proper corrective action where the power level or rate of power increase exceeds a safe limit. An ionization chamber is used to give a d-c current proportional to the radiation which in turn is proportional to the operating power level of the nuclear reactors. This current is small, from 10^{-10} to 10^{-9} amp, and the logarithmic amplifier must operate in this range. The design of the amplifier, which includes a diode as the logarithmic element, is discussed in detail.

1153 A high speed scaler design. C. W. Johnstone. AECU-364, nd. 4p.

A description of a high speed scaler design, and a discussion of scalers and their functions are given. A particular design, developed at Los Alamos, has these advantages: it is of the binary type, or scale of two, and can be built as a scale of 10, using 4 stages; it uses double triodes, and resolving times of from 0.1 μsec to 1.0 μsec are obtained, depending on the tube type and resistor sizes chosen; no variable resistors or capacitors are used, which precludes any critical adjustments; power requirements are normal. A detailed comparison of this scaler with a conventional 6SN7 scale of two is made.

1154 Measurement of masses of charged particles by grain counting in photo-emulsions. Lud van Rossum. *Compt. rend. 228*, 676-8(1949) Feb. 21 (in French).

It is assumed that a particle's energy loss per track element in a given emulsion depends only on the particle's charge and velocity. It follows that, for two particles, the ratio of residual track lengths beginning at points of equal velocity is equal to the ratio of masses. On the basis of this assumption, it was found experimentally (on 28 tracks of protons, deuterons, and tritons) that the efficiency of an emulsion, i.e., the number of visible grains per certain energy loss, is also a univocal function of the particle's charge and velocity, and, consequently, that the ratio of residual track lengths at points of equal grain density is equal to the ratio of masses. The experimental work is thus reduced to the measurement of grain densities and the construction of differential curves. Advantages of this method are shown in relation to errors in counting in saturated regions, accidental density fluctuations, variations due to track inclination, and subjective counting errors. As an application of the method, it was found for π-mesons $m_\pi = (280 \pm 15)\, m_e$, in good agreement with determinations made by other means.

1155 On the measurement of the energy of fast neutrons by photographic emulsions loaded with enriched Li^6. George R. Keepin and James H. Roberts. *Phys. Rev. 76*, 154(1949) July 1 (Letter to the editor).

Photographic emulsions of the NTA type, enriched in Li^6, were bombarded with neutrons from a mixed Po + Be source; in commercial lithium-loaded plates the disintegrations are masked by a high background of proton tracks. From 225 tracks produced by thermal neutrons from the thermal column of the Argonne heavy water pile, the ranges of the α-particle and of the triton were determined as $6.8 \pm 0.6\mu$ and $38.2 \pm 1.1\mu$, respectively. An analysis of the method indicates that it can be used to measure neutrons of energy less than 1 Mev to a precision of at least $\pm$ 0.1 Mev. In addition to extending the photographic method to neutron energies below 1 Mev this technique should also prove valuable in the measurement of the energy distribution of fast neutrons inside a material medium since collimation of the neutrons is not required and perturbations introduced by the detector are minimized.

1156 Photographic plates for use in nuclear physics. J. H. Webb. *PSA Journal 15*, 193-200 (1949).

A similar article by the author was published in *Phys. Rev. 74*, 511-32(1948) Sept. 1. It was listed in Nuclear Science Abstracts as Abstract 1-1152.

1157 On relativistically invariant equations corresponding to a definite charge and a definite energy. I. M. Gelfand and A. M. Yaglom. *Doklady Akad. Nauk S.S.S.R. 63*, 371-4(1948) Dec. 1 (in Russian).

According to Pauli's theorem, *Phys. Rev. 58*, 716(1940), definite charges cannot correspond to wave fields describing particles with integral spins, and definite energies cannot correspond to fields describing particles with half-integral spins. The proof of this theorem is based on the assumption that all these wave fields are described by a wave function having a finite number of components and satisfying a certain relativistically invariant equation. Recently many fields have been studied that are described by wave functions having an infinite number of components;

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it has been found that to these fields Pauli's theorem may not apply. In the present paper the question is investigated as to when the charge and the energy (together or separately) can or cannot be definite, in cases of invariant equations having an infinite number of dimensions.

1158 The "rest mass" of the electromagnetic radiation. Ya. P. Terletskiĭ. *Doklady Akad. Nauk S.S.S.R. 63*, 519-22(1948) Dec. 11 (in Russian).

The electrodynamical equation tying together the total electromagnetic moment P and the total energy E of a plane wave is $P^2 - E^2/c^2 = 0$. A similar relation exists between the momentum and the energy of a material particle devoid of rest mass. It follows that only a zero rest mass can be ascribed to a plane monochromatic wave. In quantum theory this is reflected in the statement that the rest mass of a single photon is zero. However, real sources of electromagnetic radiations do not emit plane waves. The real waves can be viewed as a result of a superposition of several variously directed plane waves. The author proves that for an aggregate of random plane waves the inequality $P^2 - E^2/c^2 < 0$ is true. Since, for an electromagnetic radiation in vacuum, P and E are four-dimensional vectors, the foregoing expression can be written as $P^2 - E^2/c^2 = -m_o^2c^2$, where m_o is a constant determined by the structure of the radiation. This has the form of the equation relating the momentum of a material particle, having a rest mass m_o, to its energy. Therefore, m_o can be called the rest mass of the electromagnetic radiation. The analogy can be extended to include the velocity concept, by reversing the known relativistic relation into $v = c\,[1 - (m_o c^2/E)^2]^{1/2}$. Thus, for a beam of yellow sodium light, limited by a 1 cm slit, $v = (1 - 3 \times 10^{-12})c$.

1159 Stricter uncertainty relations obtained in quantum statistics by the introduction of a complex correlation coefficient. Georges Bodiou. *Compt. rend. 228*, 540-2(1949) Feb. 14 (in French).

It is proved that the relation (L. de Broglie, *Particules à spin*, p. 30) $\sigma_A\sigma_B \geq 1/2.\overline{(AB - BA)}$ can be replaced by a stricter one, $\sigma_A\sigma_B \geq 1/2.[(\overline{\delta A\,\delta B + \delta B\,\delta A})^2 + \overline{(AB - BA)}^2]^{1/2}$; here A and B are two linear Hermite operators whose dispersions are σ_A and σ_B, so that $\sigma_A^2 = \overline{(A - \bar{A})^2}$, and $\delta A = A - \bar{A}$, $\delta B = B - \bar{B}$.

1160 Determination of the half-life of ionium. Earl K. Hyde. AECD-2648, Sept. 5, 1946. Decl. July 19, 1949. 8p. For publication in NNES.

The present paper reports a redetermination of the ionium (Th^{230}) half-life, measuring directly the specific alpha disintegration rate of an ionium-thorium mixture whose isotopic composition had been determined by mass spectrographic analysis. The value obtained in these experiments was $(8.0 \pm 0.3) \times 10^4$ yr. This compares with a value of 8.23×10^4 yr obtained by Curie and Cottell, *Comp. Rend. 190*, 1289(1930).

1161 Experiments on the effect of atomic electrons on the decay constant of Be^7. R. F. Leininger, E. Segre, and C. Wiegand. AECU-286, June 15, 1949. 7p.

In previous papers the possibility of altering the half-life of Be^7 by chemical binding was pointed out and the decay constants of Be^7 metal and Be^7O were compared, *Phy. Rev. 71*, 274(1947); *Phy. Rev. 75*, 39(1949); AECD-2199. The results with this pair were not conclusive, so the decay constants of Be^7 in Be^7O and Be^7F_2 have been determined as $\lambda_{BeO} - \lambda_{BeF_2} = (+1.375 \pm 0.053)10^{-3}\lambda_{BeO}$. This shows a definite effect of the chemical binding on the radioactive decay constant.

1162 Radiations from Hf^{181}. Erling N. Jensen. AECU-292, nd. 14p.

The radiations from Hf^{181} have been examined with a magnetic lens spectrometer. Four γ rays were found having energies of 0.087, 0.134, 0.347, and 0.485 Mev. There is evidence for the existence of a fifth γ ray. The maximum energy of the β rays was estimated to be 0.41 Mev. The three higher energy γ rays were found to have intensities proportional to 11, 29, and 100, respectively. The total internal conversion coefficient for the 0.134 Mev transition was calculated to be 11. Calculations on the lifetime and the ratio of the conversion electrons in the K and L shells indicate that in the transition from the metastable state the nucleus undergoes a spin change of three units.

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1163 K capture of Be^7 and the excited state of Li^7. R. M. Williamson and H. T. Richards. AECU-359, nd. 12p.

The fraction of Be^7 K-capture to the 478-kev excited state of Li^7 has been experimentally determined to be 0.107 ± 0.02. The experimental method consisted of measuring the number of Be^7 atoms by counting neutrons from the Li^7 (p, n)Be^7 reaction, and in observing the subsequent number of 478-kev gammas by use of a counter calibrated by beta-gamma coincidences from Au^{198}. Implications concerning the character of the 478-kev Li^7 level are discussed.

1164 A determination of the half-life of C^{14}. W. M. Jones. AECU-365, nd. 19p. Proposed for publication in *Phys. Rev.*

Experiments are described involving the counting of an analyzed and diluted sample of carbon dioxide containing C^{14} in a Geiger counter of known effective volume. The value of the half-life was found to be 5589 ± 75 yr. The method, in general, consisted of the mass spectrometric analysis of a sample of CO_2 rich in C^{14}, the dilution of a portion of this material in a known way, and the counting of a portion of the diluted material in a Geiger counter of known effective volume.

1165 Classical radioactivity, 1940-1949. N. Feather. *Nucleonics 5*, 22-41(1949) July.

The author discusses the experimental work, published since January 1, 1940, on the radioactivity of U^{238}, U^{235}, and Th^{232} and their natural decay problems. 190 references are included.

1166 On the fluorescent L-radiation and the γ-radiation of ionium. Michel Riou. *Compt. rend. 228*, 678-80(1949) Feb. 21 (in French).

Irène Curie, *Compt. rend. 227*, 1225(1948), has shown that the γ-radiation of ionium is accompanied by a soft radiation that can be identified with the fluorescent L-lines of radium. The present author submitted these radiations to a further study, using as a source a ionium-thorium mixture, (100 mg of hydrate), containing 9% ionium. The Geiger-Müller counters had 5 mg/cm^2 aluminum ends and were filled with alcohol + xenon at 10-21 cm Hg. The absorption curves in Cu, Mo, and Ag showed that the energy of the soft radiation was about 14 kev. For the separation of lines, the selective absorption was determined in elements from Z = 28 to Z = 53. The results confirmed the attribution of the spectrum to the L-radiation of Ra. Similar measurements on radioactinium revealed the same lines with approximately the same intensities. In both cases a radium isotope is formed: $_{90}Th^{230}$ (Io) $\rightarrow$ $_{88}Ra^{226} + \alpha$; $_{90}Th^{227}$ (RaAc) $\rightarrow$ $_{88}Ra^{223}$ (AcX) + α. The identity of the spectra shows that the atomic number of the formed atom alone determines the L-spectrum, and that in both cases the L level is excited as a result of an internal conversion of γ-lines: the line 68 kev in the case of ionium, eight lines 26-100 kev in that of radioactinium. On the basis of the intensities found, the relative numbers of photons corresponding to the levels L_I, L_{II}, and L_{III} could be calculated; they are L_I: L_{II}: L_{III} = 50:20:26. The γ-rays of ionium, as determined from the absorption in Cu, Ta, and Pb, are 68 and 200 kev. By assuming that the efficiency of the counters is equal to 1 - exp ($-m\mu/\rho$), (where m is the efficient superficial mass of xenon, and μ/ρ is the absorption coefficient in xenon), the intensities of the L- and γ- radiations of ionium can be given in terms of numbers of quanta per 100 disintegrations: L-lines-- 9 ± 2 quanta; 68-kev line -- 0.50 ± 0.15 quanta; 200-kev line -- 0.3 ± 0.1 quanta.

1167 On the phenomena of double electronic disintegrations. Raymond Daudel and Maurice Jean. *Compt. rend. 228*, 662-4(1949) Feb. 21 (in French).

Three different processes may lead to the result consisting of a transition from element Z to element Z-2, an emission β^+, and a capture e: (1) process a: capture e, emission β^+, or vice versa, passing through a real intermediary state; (2) process b: simultaneous capture e and emission β^+, with an emission of two neutrinos in virtual intermediary states; (3) process c: simultaneous capture e and emission β^+, without emission of neutrino, (neutrino emitted in the first virtual state is reabsorbed). It is shown that the three processes can stand in the following orders of comparative probability: in certain cases of low transition energy the order of decreasing probabilities is c > b > a, and the process may be impossible; for energies of intermediate values, a > c > b; for very high energies, a > b > c. Among other possible combinations, the phenomenon of double capture e must be rare, because of the energy coincidences it requires; the double phenomenon of a creation of e with an emission β^- is similar to that studied above.